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STATUS OF PROMOTION OF BIOTECHNOLOGY R&D

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JAPAN

STATUS OF PROMOTION OF BIOTECHNOLOGY R&D

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III. Status of Promotion of Biotechnology at Ministry of Agriculture, Forestry and Fisheries

III-1. FY91 Budgetary Measures Concerning Biotechnology-Related Matters

Biotechnological development in the agriculture, forestry, fishery and the food industry is expected to pave the road to the future for these industries through drastic improvement of productivity. Therefore, the Ministry of Agriculture, Forestry and Fisheries (MAFF) plans to carry out systematic and priority research in fundamental and pioneering fields, continually promote large-scale long-term projects for developing revolutionary technologies in each of the industries, and revise and strengthen policies for promoting implementations of R&D results.

MAFF plans to secure a total budget of approximately ¥8.3 billion for FY91 biotechnology-related matters.

Note:--This total outlay includes an outlay for tests and R&D projects appropriated for the secretariat of the Agriculture, Forestry and Fisheries Research Council and outlays for practical implementation, propagation and encouragement of new technologies appropriated by bureaus and agencies under MAFF.

(Biotechnology-Related Outlays)

(Unit: ¥1 million)

Item	FY90 Outlay	FY91 Outlay	Remark
I. Promotion of biotechnology R&D concerning advanced technologies in agriculture, forestry, fishery and food industry	3,889	3,984	
1. Promotion of fundamental and pioneering R&D projects aiming for the 21st century	3,091	3,343	
	0	372	•Research on rice genome analysis (new project)
	0	107	•Comprehensive project concerning development of new highly functional materials by altering structures of saccharides (new project)
	91	91	•Development of assessment techniques for transduction of recombinant's biosystem
	426	427	•Comprehensive project concerning clarification and optimal control of ecological orders in agriculture, forestry and fishery
	498	451	•Comprehensive project for developing new technologies in agriculture, forestry and fishery through clarification and control of biological information (Bio-media Plan)
	118	118	•Seed culture research as advanced technology in biotechnology (commissioned to universities)
	460	414	•Comprehensive research project concerning biotechnological plant breeding
	51	50	•Development of new hybrid cultivation systems for nurseries (subsidies to private sector)
	83	83	•Analysis of animal genes and development of genetic application technologies
	112	112	•Development of new steer breeding technology based on multiple pregnancy through in vitro incemination
	32	62	•Biotechnological breeding tests for designated species
	261	262	•Promotion of regional biotechnology R&D projects (subsidies to prefectures)
	533	537	•Administration of gene bank for agriculture, forestry and fishery
2. Promotion of technological innovation projects in food industry	726	565	
	89	86	•Development of technologies for altering and sophisticating food functionalities
	121	121	•Development of supply technologies for high-quality vegetables and fruits through clarifying post-harvest physiology (joint research with private sector)
	134	129	•Development of high-density, mass-culture food production system with super-high pressure
	100	95	•Development of technologies for altering enzymatic functions in food industry
	51	50	•Development of technologies for applying advanced bio-synthesis systems to increase herbicide productivity
	0	49	•Development of key technologies for producing highly functional fertilizers
	36	35	•Development of key technologies for implementing
3. Biotechnology development and strengthen practical application bases	36	36	•Establishment of biotechnology application systems through utilization of regional resources

4. Promotion of international exchange concerning biotechnology research	37	39	•Funding for OECD international joint research
			•International joint research projects concerning advanced technology development
II. Promotion of large-scale, long-term research projects	1,411	1,559	
	0	438	•Comprehensive research project concerning development of bilogical functions and application technologies for new usage creation (new project)
	142	146	•Clarification of eco-system trends and development of trend prediction technologies in agriculture, forestry and fishery in light of earth environmental changes (expanded project)
	297	299	•Development of new paddy field crops to meet increased demand (Super-rice Program)
	356	376	•Improvement of quality of field crops, primarily wheat, and development of productivity improvement technologies (new project on recombination)
	0	84	•Development of improved agricultural disease prevention technologies using biological functions including plant immunities
III. Development and application of new technologies	2,594	2,791	
1. Promotion of superior seedling supply through tissue culture	474	502	•Tissue culture-related part of superior seed and seedling supply guarantee project
2. Promotion of implementation of new agricultural technologies	208	237	•Project to promote development and practical application of artificial seeds (new project)
			•Project to promote smooth application of natural enemy organisms under control diversification promotion project (new project)
3. Promotion of implementation of new technologies in livestock industry	1,186	1,209	•Project to promote development of practical biotechnological processes applcable to livestock industry (new project)
4. Promotion of application of advanced technologies in food industry	242	342	•Development of environment-compatible food packaging technologies (new project)
5. Development and application of new technologies for lumber processing	185	191	•Project to promote utilization of tree extract components (Green Spirit Project)
6. Development and application of new technologies for marine industry	299	311	•Marine farm system development project using biotechnology (new project)
			•Fund for developing biological cleaning technology for oil pollution under fund for rescuing oil-contaminated fishery and fund for oil pollution disaster prevention (new project)
Total	7,902	8,334	

Bio-oriented Technology Research Advancement Institution (BRAIN)	3,500	3,500	Investment and loan for bio-oriented technology research projects
Japan Development Bank	4,000	4,000	Loan for promoting biotechnology industrialization
Hokkaido Tohoku Development Financial Corp.	300	300	Loan for promoting commercialization of regional biotechnology
Agricultural and Fishery Financial Corp.	Part of 24,300	Part of 23,700	Loan for joint facilities for biotechnology utilization
Agricultural Improvement Fund	100	100	Loan for virus-free seedling breeding facilities

III-Promotion of Biotechnology R&D by MAFF

1. R&D Projects and Project-Assigned Organizations

(1) Biotechnology Field

Project	Project-Carrying Organization (Consignee Organization)	FY91 Outlay (FY90 Outlay) in ¥1 million	Project Term
Comprehensive research project to develop highly functional materials through structural modification of saccharides	National Institute of Agrobiological Resources (NIAR), National Institute of Animal Industry (NIAI), Fruit Tree Research Station (FTRS), Vegetable, Ornamental Crops and Tea Research Station (VCTRS), National Institute of Animal Health (NIAH), National Food Research Institute (NFRI), National Research Institute of Forestry (NRIF), Central Fishery Research Laboratory (CFRL), Hokuriku Agricultural Experiment Station (Hokuriku AES) (Tohoku U., Fukuyama U. and Society for Techno-innovation of Agriculture, Forestry and Fishery, Inc. (STAFF))	107 (0)	FY91 ~ FY00
Comprehensive research project to clarify and optimally control ecological orders related to agriculture, forestry and fishery	National Agriculture Research Center (NARC), National Institute of Agro-environmental Sciences (NIAES), NIAI, National Grassland Research Institute (NGRI), FTRS, VCTRS, Hokkaido Agricultural Experiment Station (Hokkaido AES), Tohoku Agricultural Experiment Station (TAES), HAES, Chugoku Agricultural Experiment Station (CAES), Kyushu Agricultural Experiment Station (KAES), Sericultural & Entomological Research Institute (SERI), NIAH, NRIF, Hokkaido Regional Fishery Research Laboratory (Hokkaido FRL), Tohoku Regional Fishery Research Laboratory (Tohoku FRL), Chuo Regional Fishery Research Laboratory (Chuo FRL), Nanseikai Regional Fishery Research Laboratory (Nanseikai FRL), Seikai Regional Fishery Research Laboratory (Seikai FRL), Japan Sea Regional Fishery Research Laboratory (Japan Sea FRL), Oceanic Regional Fishery Research Laboratory (Oceanic FRL), National Research Institute of Aquaculture (NRIA), National Research Institute of Fishery Engineering (NRIFE), Hokkaido Salmon Hatchery (HSH), College of Fishery (COF) (Iwate Prefecture Institute of Animal Industry, Hokkaido U., Tohoku U., Tokyo U., Mie U., Kyoto U., Okayama U., Shimane U., Kochi U., Kyushu U., National Institute of Genetics (NIG)-MOE, Hokkaido Tokai U., Kitazato U., Meiji U., Society of Marine Industry Research, Inc.)	427 (426)	FY89 ~ FY98
Comprehensive research project to develop new technologies for agriculture, forestry and fishery through clarification and control of biological information	NARC, NIAR, NIAES, NIAI, FTRS, VCTRS, Hokkaido AES, TAES, KAES, SERI, NIAH, NFRI, NRIF, Tohoku FRL, Chuo FRL, Nanseikai FRL, NRIA, COF (Tohoku U., Tsukuba U., Tokyo U., Tokyo U. of Agriculture and Technology (TUAT), Osaka U., Shimane U., Kagawa U., Nagoya U., Kumamoto U., Taichiku U., Hokkaido U., Fujita-Gakuen Health U., Teikyo U., Tokyo Institute of Technology (TIT), Gumma U., Saga U., Okazaki National Cooperative Research Organization (ONCRO), Saitama Medical College)	451 (498)	FY88 ~ FY97
Analysis of animal genes and development of application technologies	NIAI, SERI, NIAH, Chuo FRL, Seikai FRL, NRIA (ONCRO, Kyoto U.)	83 (83)	FY91 ~ FY95
Development of new breeding technology for high-meat-yielding steer based on plural pregnancy through in vitro fertilization	NARC, NIAI, NGRI, Hokkaido AES, TAES, CAES, KAES, NIAH (Kitazato U., Livestock Improvement Technical Center of Livestock Improvement Foundation, Inc.)	112 (112)	FY88 ~ FY92
Comprehensive research project concerning biotechnological plant breeding	NARC, NIAR, NIAES, NGRI, FTRS, VCTRS, Hokkaido AES, TAES, CAES, Shikoku Agricultural Experiment Station (SAES), KAES, SERI, NFRI, Tropical Agriculture Research Center (TARC), NRIF, Seikai FRL (Tokyo U., Saitama U., Nagoya U., Kyoto U., Kyoto Institute of Technology (KIT), Kyoto Prefectural U.)	414 (460)	FY86 ~ FY00
Development of assessment techniques for introducing recombinant biological system	NIAR, NIAES, NIAH, NFRI, NRIF (Tsukuba U., Tokyo U., TIT, Science U. of Tokyo, Teikyo U., Japan Plant Health Association, Inc., Takara Shuzo Co., Ltd., Shimadzu Corp., Safety Science Research Institute of Mitsubishi Chemical Industries Ltd., Biosystem International Inc., STAFF)	91 (91)	FY90 ~ FY92
Development of supply technology for high-quality vegetables and fruits through clarification of post-harvest physiology	FTRS, VCTRS, Hokkaido AES, CAES, SAES, National Research Institute of Agricultural Economics (NRIAE), NFRI (Nagoya U., Chiba Prefectural Agricultural Experiment Station)	121 (121)	FY90 ~ FY94

(2) Other Related Fields

Project	Project-Carrying Organization (Consignee Organization)	FY91 Outlay (FY90 Outlay) in ¥1 million	Project Term
Comprehensive research project to develop biological functions and their application technologies for creation of new demands	NARC, NIAR, NIAES, NIAI, NGRI, FTRS, VCTRS, Hokkaido AES, TAES, Hokuriku AES, CAES, SAES, KAES, SERI, NIAH, NFRI, NRIF, Chuo FRL, NRIA, COF (Tohoku U., TUAT, Toyama U., Mie U., Kyoto U., Tokushima U., Kyushu U., Rakuno Gakuen U., Tokyo College of Pharmacy, Hokkaido Prefectural Forestry Experiment Station, Iwate Prefectural Sericultural Experiment Station, Yamagata Prefectural Sericultural Experiment Station, Miyagi Prefectural Agricultural Junior College, Ehime Prefectural Technical Center, Okinawa Prefectural Agricultural Experiment Station, Asahi Yushi Corp., Oji Paper Co., Ltd., Mitsui Norin Co., Ltd., Mitsubishi Rayon Co., Ltd.)	438 (0)	FY91 ~ FY00
Development of new-type paddy field crops to expand demand (Super-rice plan)	NARC, NIAR, Hokkaido AES, Tohoku AES, Hokuriku AES, CAES, SAES, KAES, NFRI, TARC (Chiba U., TUAT, Nagoya U., Kyoritsu Women's U., Fukuyama U., Hokkaido Prefecture Kamigawa Agricultural Experiment Station, Aomori Prefecture Agricultural Experiment Station, Miyagi Prefecture Furukawa Agricultural Experiment Station, Niigata Prefecture Food Research Institute, Toyama Prefecture Agricultural technical Center, Fukui Prefecture Agricultural Experiment Station, Aichi Prefecture Integrated Agricultural Experiment Station, Aichi Prefecture Food Industry Experiment Station, Nara Prefecture Agricultural Experiment Station, Hiroshima Prefecture Food Industry Technical Center, Miyagi Prefecture Integrated Agricultural Experiment Station, Kagoshima Prefecture Agricultural Experiment Station, Kameda Seika Co., Ltd., Toyo Suisan Kaisha, Ltd., Kikumasamune Shuzo Co., Ltd.)	290 (297)	FY89 ~ FY95
Development of technologies for improving quality and productivity for field crops, primarily for wheat	NARC, NIAES, NIAI, NGRI, National Research Institute of Agricultural Engineering (NRIAE), Hokkaido AES, Tohoku AES, Hokuriku AES, CAES, SAES, KAES, NFRI (Japan Society of Grain Sanction, Inc., Hokkaido Prefecture Kitami Agricultural Experiment Station, Hokkaido Prefecture Central Agricultural Experiment Station, Hoshino Bussan Co., Ltd., Fukui Prefecture Agricultural Experiment Station, Tochigi Prefecture Agricultural Experiment Station, Nagano Prefecture Chushin Agricultural Experiment Station, BRAIN)	376 (356)	FY91 ~ FY96
Trend search and prediction capability development for eco-systems concerning agriculture, forestry and fishery in changing earth environment	NARC, NIAR, NIAES, NGRI, FTRS, Tohoku AES, Hokuriku AES, KAES, NRIF, Chuo FRL, Japan Sea FRL, COF (Tohoku U., Tsukuba U., Tokyo U., Kyoto U., Osaka City U.)	146 (142)	FY90 ~ FY95
Development of better health preservation technologies for agricultural products by using biological functions including plant immunity	NARC, NIAR, NIAES, NGRI, Hokkaido AES, Tohoku AES, Hokuriku AES, CAES, SAES, KAES, SERI, NIAH, NFRI (Ibaragi U., Kyoto Prefectural U., Chiba U.)	84 (0)	FY91 ~ FY95

2. Description of Research Project

<Biotechnology Field>

(1) Comprehensive research project to develop highly functional materials through structural modification of saccharides

(FY91 through FY00) (FY90 Outlay: ¥0)

FY91 Outlay: ¥107 million

A. Objectives

Saccharides not only constitute the essential components of biological polymers, such as cell membranes, but also are said to play a key role as the molecules that compose the actively functional segment of various physiologically active substances. The objectives of this project are to clarify the relationship between structure and function of saccharides, establish technologies for altering and improving saccharides' functions and for preparing and mass-producing saccharides with new functionality, and develop highly functional materials for the next generation with emphasis on the biological control functions of saccharides.

B. Research Approaches

i. Research concerning relationship between saccharide chains and intercellular interactions.

*The structure and role of polysaccaride oligosaccharides that induce biological defensive reactions at the surface layers of plants' cells will be clarified, and basic knowledge will be obtained for controlling the production of environment-friendly herbicides and secondary metabolic products.

*The role of saccharide chains specifically for the fertilization of livestock animals will be clarified, and attempts will be made to introduce a saccharide engineering technique to fertilization control.

ii. Research concerning relationship between saccharide chains and the plants' straight growth, and differentiation or steady state maintenance.

*The structure and function of saccharide chains that affect the straight growth and differentiation of plants will be clarified in order to broaden the technical possibility of crop cultivation.

*The role of saccharide chains in metabolic control and immunity mechanisms of livestock animals will be clarified in order to help establishing a control technology for energy metabolism and a defense technology against diseases through application of these saccharide chains.

iii. Development of synthetic processes for new, useful saccharides.

*The structure of polysaccharides, including oligosaccharides, with new functions and enzyme systems related to the polysaccharides will be studied in order to develop efficient synthesis technologies for useful saccharides, and to aggressively apply the new saccharides for food production.

C. Anticipated results

i. Through the clarification of saccharide chain-related enzymes, useful saccharide synthesis systems and their application fields, mass-production techniques for functional saccharides are expected to be developed.

ii. Techniques for modifying the structures of physiologically active substances and food materials for improving their functions or imparting new functions to them are expected to be developed after the mechanisms that govern the characteristics and functions of various saccharides have been understood.

iii. Through the introduction of saccharide-related enzymatic genes, it is expected to become possible to cultivate microrganisms that have drastically new characteristics including high productivity for a functional saccharide.

iv. New agriculture, forestry and fishery materials, including highly functional herbicides, animal drugs, physiologically active substances, such as plant growth promoters, and food materials are expected to be developed through the addition of a newly created saccharide.

(2) Comprehensive research project to clarify and optimally control eco-systems in agriculture, forestry and fishery

(FY89 through FY98) (FY90 Outlay: ¥426 million)

FY91 Outlay: ¥427 million

A. Objectives

i. Efforts are being made in agriculture, forestry and fishery, in improving productivity of healthy and diverse foods by always ensuring harmony with eco-systems to maintain long-term

harvesting fields while maintaining reliable supplies. Satisfatory development is hoped for a herbicide-less production technology by using a biological function, resource broadening technology based on the ecology of food fish, including shell fish, and a semi-natural grassland utilization technology for pasturage.

ii. The advancement of science and technology revealed that, in an ecological system, many life activities, such as behavior, breeding, growth and succession, of living organisms are controlled by inter-organism operating factors, including a variety of organism-derived, minute-quantity chemical substrances (pheromones and allelopathies) and physical causes (sound, light and temperature). These excellent controls are considered to be the naturally endowed control functions of the organisms.

iii. Therefore, in this project, these factors associated with inter-organismic actions will be clarified, and aggressively utilized in order to develop control and production technologies and optimal control technologies for the living environment of biological resources in agriculture, forestry and fishery.

B. Research Approaches

i. Clarify the weed growth prevention or herbicidal technology demonstrated by the families of compositae (himejoon) and gramineae (oat) with an allelopathy. (Thus far, gramicidin of barley and 2-cis DME of solidago altissima have been identified.)

ii. Develop insect-utilization technologies, such as new insecticidal technologies against harmful insects and improvement of pollination efficiency for fruit trees, by using biological correlation substances including pheromones (e.g., male and female moths (species: shiroichimoji-madara-meiga)), kairomone (e.g., cockroaches and parasitic bees) and allomone (e.g., flower bees and fruit trees), which cause reactions between insects.

iii. Develop technologies to prevent or eliminate harmful microbes by applying inter-microbial antagonistic action (e.g., rice hull bacillus subtilis vs. leaf microbe).

iv. Develop technologies to prevent or eliminate crop diseases through stabilization of crop

resistance by utilizing co-evolution mechansim (evolution of two or more organisms resulting from mutual interactions) between organisms, e.g., rice -- rice striped leaf disease virus -- delthacodes striatella.

v. Develop a low-cost cattle grazing technology by constantly maintaining and effectively utilizing semi-natural grasslands by taking advantage of allelopathies between grass species; and of diet control for cattle using olfactory-sense stimulants on semi-natural grasslands (wild grass lands), such as Kitakami highlands and Aso region (reed canary-grass is known to have a high nutritional value, although not favored by cattle).

vi. Develop marine productivity (e.g., production of sea urchins and abalones, and attraction of more fish with seaweeds)-increase technologies in reef areas by taking advantage of allelopathy between plant planktons (red-tide planktons, including those of diatoms, and (fukurin-amiji)) and between plants and food animals (sea urchins and abalones).

vii. Develop a resource expansion technology (by increasing the return rates of salmons and trouts) by taking advantage of the fishes' biological auto-gyro-function, which controls their homing mechanisms, and any odorous substances associated with the fishes' memory of spawning rivers.

viii. Develop a resource supply fluctuation prediction technology through the clarification of the relationship between sardines, other fish and animal and plant planktons (only a very few fish species other than sardines directly eat plant planktons).

ix. Develop a technology to promote the conversion of low-utility natural forest, consisting of kamba [phonetic] and shide [phonetic], into useful, wide-leaf trees, such as beeches and Japanese oaks, by utilizing the transition mechanism of forest vegetation.

(3) Comprehensive research project concerning development of new technologies in agriculture, forestry and fishery through clarification and control of biological information

(FY88 through FY97) (FY90 Outlay: ¥484 million)

FY91 Outlay: ¥451 million

A. Objectives

Physiologically active substances that cause the manifestation of biological functions, and the recognition and transmission of various information (biological information) including external stimuli, and the manifestation mechanisms will be studied at several levels ranging from the molecular level to the species. Attempts will be made to develop technologies to optimally control the mechanisms and have a potential or undeveloped function of an organism manifested to the fullest extent.

B. Research approaches

i. Common key technologies

*Molecular recognition and response

Clarification of molecular-level mechanisms of recognizing, transmitting and responding to stimuli and information within an organism's body

*Ultra-micro-analytical technologies

Develpment of ultra-high-precision analytical technologies for biological information-carrying substances, such as hormones and enzymes.

ii. Clarification of biological information recognition, transmission and manifestation mechanisms

*Optimal control of growth and differentiation

The growth and differentiation of plants and the metamorphosis and hybernation phenomena of invertebrate animals will be studied, and the re-differentiation of plant from cells, the plant dwarfing technology, and a new biological insecticidal technology will be developed.

*Optimal control of maturation and spawning

The propagative and lactational functions of domestic animals and the spawning rhythm of fish will be clarified in order to develop technologies for increasing the propagative and lactational functions and for reliably producing superior hatchlings.

*Increase of immunity function

Biological defense mechanisms against the intrusion of foreign objects, e.g., immunity of domesticated animals and the eating and encircling actions by invertebrate animals will be

clarified to develop technologies through immunity function reinforcement for preventing these animals from becoming sick or being infected by a disease.

*Utilization of symbiosis

The symbiotic phenomenon between a plant host and VA mycorrhiza bacteria or root nodule bacteria will be clarified in order to develop a high-yield harvesting technology for crops through active utilization of the phenomenon.

*Reinforcement of resistance

Plants' mechanisms of resisting or adapting to various external stresses (temperature, moisture and salts) will be clarified to develop a new growth management technology in an undesirable environement, and a technology for efficiently utilizing biological resources through the use of resistant bacteria.

(4) Project concerning analysis of animal genes and development of gene utilization technology

(FY89 through FY95) (FY90 Outlay: ¥83 million)

FY91 Outlay: ¥83 million

A. Objectives

The main objective of this project is the creation of breeding specimens that are equipped with the production capability for a useful substance, such as a physiologically active substance, and a new form by applying genetic engineering, which has recently made fantastic progress, to the animal field. Initially, useful genes of animals (domestic and marine animals and insects) will be isolated, their structures will be analyzed, and their manifestation control mechanisms will be clarified. Based on results of these gene analyses, a technology to transduce such a useful gene into a cell or an early-stage embryo will be developed. Through these studies, it is expected that the production of useful substances, including vaccines and interferons without any side effects, will become possible. It is also expected that epoch-making breeding specimens be created through the interspecific gene transduction.

B. Research approaches

i. Analyses of structures and functions of useful genes

Useful genes, including fibroin genes of insects, interferon genes of pigs, virus-antigenic proteins, will be isolated and structurally analyzed. The analyses will be followed by the clarification of mutual actions between control gene groups that govern protein synthesis.

ii. Development of production technology for useful substances

A technology will be developed for transducing genes to culture cells in order to produce useful substances including hormones and vaccines. At the same time, cells that are suitable for the production of substances by genetic transduction will be prepared, and their cultivation technology will be developed in order to develop a mass-production technology for a useful substance.

iii. Development of new breeding specimens

Vectors will be developed for transducing genes into early-stage embyos, and a technology will be developed to enable the manifestation of foreign genes transduced with the vectors.

(5) Project to develop a new breeding technology for high-meat-yielding cattle based on plural procreation through in vitro insemination

(FY88 through FY92) (FY90 Outlay: ¥112 million)

FY91 Outlay: ¥112 million

A. Objectives

In order to reduce the high-meat-yielding cattle-breeding cost which occupies a major portion of the beef production cost, technologies will be developed to breed multiple calves with in vitro-fertilized eggs, and to efficiently nurture the new-born calves into high-meat-yielding cattle.

B. Research approaches

i. Development of a mass-production technology for in vitro-fertilized eggs and reliable multiple impregnation technology.

*Development of a mass-collection technology for immature eggs from ovaries.

*Development of a total in vitro cultivation system of in vitro inseminated eggs to reduce the cost of fertilized egg production.

*Development of a stable polyembryonic breeding technology through, first, the promotion of the implantation of plural fertilized eggs onto a uterus and, secondly, the prevention of a miscarriage.

ii. Development of an efficient nurturing technology for multiple-birth calves

*Development of a nursing technology for multiple-birth calves through the clarification of their physiological characteristics and nutritional requirements.

*Development of a overall disease prevention and elimination system for preventing the loss of multiple-birth calves due to dieases.

*Development of a growth acceleration technology for multiple-birth calves through the promotion of rumen fermentation which is optimal for growth.

*Development of a growth acceleration technology through intensive grazing with consideration of high-nutritive grass utilization, periodical pasture rotation and pasture stress alleviation.

(6) Comprehensive research project concerning biotechnological plant breeding

(FY86 through FY00) (FY90 Outlay: ¥460 million)

FY91 Outlay: ¥414 million

A. Objective

Epoch-making, biotechnology-derived technologies for Japan's agriculture, forestry and fishery need to be developed to expect any new developments in these fields.

B. Research approaches

i. Development of key technologies including cell manipulation and DNA recombination

To be developed primarily for rice and wheat plants are the genetic recombinant key technologies including cell and tissue cultivation, efficient cell fusion, vector-using insertion of foreign genes, and direct electrical introduction of useful genes.

ii. Preparation of new breeding specimens equipped with improved environmental stress resistance and enriched specific components

Breeding specimens will be created with new functions, which include improved environmental stress resistance, e.g., resistance to diseases and damages, enriched specific components, e.g., stored proteins, and improved material synthesis and conversion functions, e.g., photosynthesis and nitrogen fixation.

iii. Creation of new, epoch-making varieties and useful plants equipped with new functions

Useful plants will be created from the new breeding specimens mentioned in ii above.

(7) Development of assessment technique for the introduction of recombinants to eco-systems

(FY90 through FY92) (FY90 Outlay: ¥91 million)

FY91 Outlay: ¥91 million

A. Objectives

Today, biotechnology has advanced so much that various recombinants are on the verge of entering the field test phase. Therefore, attempts will be made to establish assessment techniques for introducing a recombinant into an eco-system by developing the following techniques through utilizing the most advanced molecular biological methods: a high-speed, high-sensitivity detection technique for recombinants, a technique of evaluating the effects of a transduced gene on an eco-system, and a highly safe recombinant management technique.

B. Major technical development projects

i. Development of a fast and sensitivie recombinant detection technique

ii. Evaluation of effects of a transduced gene on an eco-system

iii. Development of a simple indexing method for important influential factors

iv. Development of a highly safe management method in an open system

(8) Project for the development of a supply technology for high-quality vegetables and fruits through clarification of post-harvest physiology

(FY90 through FY94) (FY90 Outlay: ¥121 million)

FY91 Outlay: ¥121 million

A. Objectives

In order to assure the supply of high-quality vegetables and fruits to satisfy the demands by consumers and the food industry, post-harvest physiological mechanisms will be genetically clarified, and a technology to improve the quality of vegetables and fruits will be developed for each stage of distribution, storage and cultivation.

B. Research approaches

i. Demands by consumers and the food industry will be analyzed, and the elements for unprocessed edibility and processability (sweetness, hardness and aroma) will be identified to meet the demands.

ii. Changes of these elements after harvest and during storage will be studied enzymaticially and genetically.

iii. Based on information obtained by the above-mentioned studies, a technology for improving the quality of vegetables and fruits will be developed for each stage of distribution, storage and cultivation.

<Other Related Fields>

(1) Comprehensive research project concerning development of biological functions and function utilization technologies in order to create new demands

(FY91 through FY00) (FY90 Outlay: ¥0)

FY91 Outlay: ¥439 million

A. Objectives

While consumers' needs in clothing, eating and housing are becoming more diversified and more sophisticated, the existing structures for production and consumption are becoming the nemesis for eco-systems and global environmentals.

At the same time, under the current conditions of sluggish consumption growths for agricultural, forestry and fishery products, it is necessary to expand the existing uses and stimulate the creation of new demands for these products in order to promote further progress in agriculture, forestry and fishery to vitalize agricultural, woodland and fishing communities.

Under these circumstances, one of the objectives of this project is to develop high-quality biological materials that will be in accord with eco-systems and will not be dependent upon fossilized resources by efficiently utilizing the delicate and diverse material production functions of plants and marine creatures. Another objective of this project is to integrate technologies into a system to establish the production bases for these biological materials to be developed in each region.

B. Research approaches and anticipated results

i. Development of industrial raw materials that do not depend on fossilized resources and originate from agricutural, forestry and marine products based on the natural cycles of substances.

(a) Development of biologically degradable plastics

Raw materials, including starches and proteins from agricultural products, and lignins and celluloses from lumbers will be utilized to develop plastics that will be readily degraded, instead of being accumulated in natural environments.

(b) Development of biological energy

A technology will be developed to efficiently produce ethyl alcohol, which will be a non-polluting energy raw material, from sugar beets and sweet sorghams.

ii. Search, clarification and improvement of biological functions, and development of new demands through application of these functions

(a) Development of foods and clothes with new characteristics

Attempts will be made to expand existing uses through improvement of certain biological products in the food and clothing fields. These new biological products include a new sweet potato species that is reinforced with useful components including soy bean, from which the allegy-causing allergen is removed; vitamins and edible fibers; and a new silkworm breed that produces super-fine silk threads with a thickness approximately one half of the ordinary silk fiber.

(b) Development of efficient production and application technologies for useful biological components through better utilization of land resources

Useful components, such as natural dyes and functional sugars, will be searched and evaluated.

Also, efficient production and application technologies of these materials will be developed through the modification of biological metabolic functions.

(c) Development of biological environmental preservation and improvement technologies

Attempts will be made to preserve and improve agricultural and marine environments through developments of grasses that do not disperse pollens, method of utilizing the soil-accumulated phosphoric acid-solubilizing function of kimame [phonetic], and water-purification technology by means of aquatic creatures including planktons and algae.

iii. Promotion of agriculture, forestry and fishery through better utilization of regional resources and natural environment

(a) Development of technologies for vitalization of cold-district agriculture, forestry and fishery in Hokkaido

More diversified utilization will be sought for useful components of potatoes which are the key crop of Hokkaido, and a new sugar beet variety will be sought for better alcohol production. In addition, efforts will be made to convert herianphus tuberosus's inulin into an oligosaccharide, and to produce and utilize willows and (kambas [phonetic].

(b) Development of utilization technology for regional environments that combine animal husbandry in forest and agriculture-forestry primarily in Tohoku and Hokuriku Districts

Production and utilization technologies for deer meat, hides and antlers, and efficient production and utilization technologies for wild silkworms will be developed in the combined field of animal husbandry in forest and agriculture-forestry. Through the characteristics reinforcement, attempts will also be made to expand the demand for soybeans and rapeseeds which are the crops suited to these districts.

(c) Development of efficient production and utilization technologies for useful components of agricultural products in the Tokai, Kinki and Shikoku districts

Efficient production and utilization technologies will be developed for functional sugars from (yakon), mid-range fatty acids and strong antioxidants from sesamum and the kufea

[phonetic] genus, and functional components including saponin flavonoid from citrus fruits and teas.

(d) Development of technologies for vitalization of agriculture in the warm district, mainly in the Kyushu District

Sweet potatoes, the primary field crop in the Kyushu District, will be fortified with useful components, such as vitamins and dyes, in order to expand their utilization. Production and utilization technologies will also be developed for broad-leaved trees, including morishima acacia, which grow fast in the life's early stage.

(2) Development of new-shape paddy field crops for demand expansion

(FY89 through FY95) (FY90 Outlay: ¥297 million)

FY91 Outlay: ¥299 million

A. Objectives

i. While the measure for establishing paddy field agriculture is being promoted, the increased production of rice and the expanded demands for rice are urgently needed. Thus, the creation of a new rice variety to suit users' requirements and the development of rice utilization technologies are becoming important issues.

ii. Although rice can take many different forms, previous research has attached too much importance to the quality of rice as the staple. Thus, the application of rice in the process fields has lagged, and it is necessary to develop technologies to enable rice in various forms to be applied in broad areas.

iii. In order to reduce production cost, it is necessary to promote the develeopment of productivity improvement technologies, including the develeopment of permanently super-high yield varieties.

iv. Therefore, it is time to move a step forward from the previous R&D level of studying rice breeding and new rice variety cultivation technology (R&D concerning pre-harvest stages). It is necessary to promote the feedback of consumers' needs, and pursue R&D concerning technology development of production through utilization of rice in various forms to increase the demand for rice.

B. Research Approaches

i. Development of new breeding method

Genes that will increase the yield of a hybrid between the Japan and India-type rice plants will be sought, and utilization technology for the hybrid will be developed. Attempts will be made to improve the breeding efficiency by developing a new breeding method that does not depend on usual sexual seeds resulting from the pollination.

ii. Clarification of characteristics of new forms and development of new varieties

Genetic resources that will be useful in drastically altering grain components have been prepared and accumulated through the "Super-extra-yield" project.

Therefore, the physical properties, including viscoelasticity, of these genetic resources, and the chemical properties of their major components, such as starches and fats, and minute-quantity components including inorganic components, dyes and aromatic components will be studied. Through the understanding of these properties, new varieties in a new form that will contribute to new utilization of the new varieties, will be developed.

In addition, the taste characteristics of foods will be studied in order to be able to objectively evaluate food tastes. The evaluation method will be used to create super-delicious tasting food ingredients.

iii. Establishment of low-cost, paddy-field crop-rotation farming technology system

A valuable, steady crop-rotation technology system will be established by integrating technologies developed in this project.

(3) Improvement of quality and productivity for crops, particularly wheat

(FY91 through FY96) *(FY90 Outlay: ¥355 million)

FY91 Outlay: ¥376 million

A. Objectives

Recently, increasingly higher-quality and less expensive domestic farm products have been urgently desired due to more sophisticated consumers' needs. On the other hand, in order to plan a more efficient utilization of crop farms, it is urgently desired to cultivate high-quality, high-yield new varieties and establish a valuable, steady production technology for these varieties with primary targets on major field crops

including wheat and soybeans.

A new variety of wheat that will surpass the quality of the imported wheat (ASW) will be cultivated, and attempts will be made to improve the productivity of rotational crops including soybeans. Based on these studies, technologies will be developed for quality stabilization and productivity increase for rotational field crops. Data obtained with these studies will be used to strengthen the management basis for regional crop rotation farming in this integrated R&D project.

B. Research approaches

i. Improvement of wheat quality

In addition to the improvement of efficiency in breeding, the mechanism of amylose decline, which is the major cause for wheat's inferior quality will be studied, and a preventive measure will be developed. Moreover, higher-quality varieties will be cultivated through the clarification of the flour-producing capability, color-developing capability and the characteristics of major components.

ii. Productivity increase for high-quality soybeans and its utilization

A new soybean variety that lacks lipoxygenase, the source of the typical soybean-like offensive odor, will be cultivated. A reliable production technology will be established for high-quality soybeans through the elimination of quality-deteriorating factors including cracked beans and insect-caused diseases.

In addition, attempts will be made to improve the quality and productivity of feed crops which are important products of crop rotation.

*FY90 outlay represents the figure for the "Field Crop Farming" project prior to the project reorganization.

(4) Study of trends of field, wood and marine eco-systems due to changes in global environment, and development of prediction technology

(FY90 through FY95) (FY90 Outlay: ¥142 million)

FY91 Outlay: ¥146 million

A. Objectives

Recently, our environment has been rapidly changing on a global scale, e.g., the sharp rise in the carbon

dioxide concentration and the earth's warming trend. These changes have caused serious concerns for the future of mankind. Thus, the "Inter-governmental panel concerning climate change" has been established, and Japan is expected to contribute heavily to the cause.

Therefore, in this project, trends in farm, woodland and marine eco-systems, which accompany the global environmental changes, will be studied with the understanding that these environmental changes are regional in nature. Based on this study, a prediction technology will be developed for the changes of the production volume and region of each of the various agricultural, woodland and marine products, for planning countermeasures.

B. Research approaches

i. Study of trends in farm, woodland and marine eco-systems which accompany the global environmental changes, and prediction of shifts toward more favorable production in agriculture, forestry and fishery

In order to be able to accurately predict the effects of global environmental changes on agriculture, forestry and fishery, information will be gathered from available data worldwide and from experiments to be carried out under controlled environments.

Based on the information gathered, a technology for predicting production shifts for major crops will be developed. This technology will be used to predict shifts in production volumes and areas in agriculture, forestry and fishery in Japan as well as throughout the world. These predictions will also be done from the socio-economic viewpoint.

ii. Study of carbon dioxide trends in farm, woodland and marine eco-systems

Gains and losses of carbon dioxide in farm, woodland and marine eco-systems will be quantitatively studied, and the movement of carbon dioxide at the boundaries of the atmosphere and the earth's surface will be studied in order to analyze the effects of environmental changes on the carbon dioxide balance.

(5) Development of technology to improve the safety aspects of agricultural products by utilizing biological functions including plant immune actions

(FY91 through FY95) (FY90 Outlay: ¥0)

FY91 Outlay: ¥84 million

A. Objectives

Recently, consumers have changed the emphasis in their demand toward agricultural products from quantity to quality, and their have rapidly become more concerned about the safety aspects of agricultural products, as seen in the aggressive movement to request safety as an added value in these products. Moreover, agriculture with the suppressed use of chemicals is being promoted in order to preserve environments. Under these circumstances, it is important to try harder to secure the safety of agricultural products by continuing the "natural enemy-employing insecticidal technology development project" which has already been underway.

Thus, in this project, with the targets of major crops (rice, wheat, barley and soybean) and feed crops, attempts will be made to develop technologies for minimizing the use of chemicals by utilizing biological functions, including plant's immune actions, and technologies for minimizing microbially produced biological toxins in agricultural products.

B. Research approaches

i. Development of technologies requiring minimum use of chemicals

a. Study of plant's biological defense mechanisms

b. Development of disease control technologies with plant's immune actions

c. Development of technologies to control harmful insects with their natural enemies

d. Study of the microbial decomposition mechanisms of herbicides, and development of technologies to control the decomposition processes

ii. Development of technologies to minimize microbial toxins

a. Development of highly sensitive detection technologies for microbes and biological toxins produced by them

b. Development of technologies to control the production of microbial toxins in the cultivation and storage processes

c. Development of technologies to minimize microbially produced biological toxins

III-3 Promotion of Regional Biotechnology R&D Projects

1. Subsidies for prefectural R&D projects

A. Reinforcement of biotechnological breeding in designated breeding test projects

FY91 Outlay: ¥32 million (FY90 Outlay: ¥32 million)

i. Objectives

Biotechnological breeding techniques will be introduced and strengthened to further promote the development of superior varieties as soon as possible by shortening breeding cycles and by efficiently utilizing genetic resources in breeding tests which have been consigned to designated prefectural testing and research organizations as a part of the Government's research test project.

ii. Specific items to be strengthened during FY91

•Shortening of breeding cycles by anther culture (rice and wheat)

•Cultivation of actual biological varieties by anther culture (tea)

•Cultivation of new varieties by embryo and young-head culture (grapes, yellow peaches, tulips and pasturage)

•Cultivation of new varieties by cell fusion (soybean, potatoes, pasturage and loquats)

•Preservation of genetic resources by cell and tissue culture (lilies)

B. Promotion of regional biotechnological R&D projects

FY91 Outlay: ¥261 million (FY90 Outlay: ¥261 million)

In cooperation with regional government agricultural experiment stations, attempts will be made to biotechnologically improve regional biological resources and develop application technologies for the resources through joint research projects with prefectural research organizations.

i. Objectives

In order to promote technical development in selected fields for which basic data have been obtained by the Government research organizations and which appear important and potentially applicable, joint research projects will be carried out with prefectures with high research capabilities under the

Governmental guidance and coordination and with the assistance of universities, if necessary. These joint research projects are also expected to contribute to the promotion of enthusiasm and the improvement of standards in regional biotechnology research.

ii. FY91 Projects and participating organizations

Project Title	Participating Organization
(Agriculture Fields) 1. Development of planned seedling production system by improving assimilatability of and preserving cultivated seedlings (FY91 - FY95)	NIAR; VCTRS; CAES; KAES; Fukushima, Niigata, Fukui, Aichi, Mie, Wakayama, Shimane, Hiroshima, Yamaguchi, Ehime and Saga Prefectures
2. Development of regional crop improvement technology by non-symmetrical cell fusion (FY91 - FY95)	NIAR; FTRS; VCTRS; SAES; Aomori, Miyagi, Osaka, Tottori, Kochi and Nagasaki Prefectures
3. Development of mass-production technology for high-quality embryos by means of in-vitro fertilization (FY91 - FY95)	NIAI; HAES; TAES; CAES; Hokkaido, Iwate, Yamanashi, Shiga, Tokushima and Kumamoto Prefectures
4. Establishment of advanced anti-multi-viral technologies (FY91 - FY95)	NARC; HAES; TAES; SAES; Hokkaido, Tochigi, Saitama, Kyoto, Oita and Okinawa Prefectures
5. Development of technologies to introduce external genes for regional crops (FY91 - FY95)	NIAR; VCTRS; NARC; TAES; KAES; Akita, Yamagata, Ibaragi, Gumma, Nagano, Shizuoka, Hyogo, Nara and Kagoshima Prefectures
6. Development of cultivation and utilization technologies for haplont crops by means of ovule, anther and pollen cultures (FY91 - FY95)	VCTRS; NIAR; Hokuriku AES; KAES; Ishikawa, Kanagawa, Gifu, Okayama, Kagawa and Miyazaki Prefectures
7. Development of functional food ingredients by means of enzymes and microbes (FY91 - FY95)	NFRI; Toyama, Chiba and Fukuoka Prefectures
(Forestry Fields) 1. Improvement of breeding and cultivation technologies for mushrooms for nursery cultivation (FY91 - FY95)	NRIF; Ibaragi, Tochigi, Nagano and Shizuoka Prefectures
2. Development of artificial inoculation technology for mycorrhiza bacteria (FY91 - FY95)	NRIF; Iwate, Fukushima, Shiga, Kyoto and Nara Prefectures
3. Development of seedling proliferation technology from elite trees (FY91 - FY95)	NRIF; Ishikawa, Gifu, Mie, Hiroshima, Kumamoto, Oita and Miyazaki Prefectures
(Fishery Fields) 1. Development of new regionally-suitable laver varieties by means of protoplast seedlings (FY91 - FY95)	Seikai FRL; Fukuoka Prefecture Ariake Fishery Experiment Station; Saga Prefecture Ariake Fishery Experiment Station; Aichi Prefecture Fishery Experiment Station; and Hyogo Prefecture Fishery Experiment Station
2. Development of production technologies for large fish or high-value fish through establishment of sterilization technology (FY91 - FY95)	Hokkaido FRL; Tohoku FRL; Chuo FRL; Seikai FRL; and Japan Sea FRL
3. Creation of new, regionally suitable varieties through establishment of morphological fixation technology (FY91 - FY95)	Hokkaido Prefecture Marine Hatchery; Aomori Prefecture Fishery Experiment Station; Fukushima Prefecture Fishery Experiment Station; Nagasaki Prefecture Research Institute of Aquaculture; Kumamoto Prefecture Fishery Research Center; Toyama Prefecture Fishery Research Laboratory
4. Development of large shellfish production technology or production period expansion technologies through establishment of sterilization technology (FY91 - FY95)	Nanseikai FRL; National Research Institute of Aquaculture (NRIA); Ehime Prefecture Fishery Experiment Station; and Hiroshima Prefecture Fishery Experiment Station

2. Subsidies to prefectural activities for propagation and promotion of biotechnology

A. Promotion of elite seedling supply by means of tissue culture

FY91 Outlay: ¥503 million (FY90 Outlay: ¥474 million)

The projects listed in the table below are now being carried out to systematize the production,

multiplication and supply of elite seedlings including virus-free seedlings which have been biotechnologically created.

Project	Main Organizations in Charge
High-efficiency multiplication and supply measures for elite vegetable seedlings	Prefectural governments, municipal governments and agricultural cooperatives
Stable supply of elite seedlings of potatoes including sweet potatoes	Prefectural governments, and agricultural cooperatives
New fruit tree variety breeding	Prefectural governments, except Tokyo, and federations of agricultural cooperatives
Establishment of production facilities for elite flower tree varieties	Prefectural governments, municipal governments, federations of agricultural cooperatives and agricultural cooperatives
Promotion of arum root production from virus-free seedlings	Japan Special Agricultural Product Association, Inc.

B. Promotion of implementation of new animal husbandry technologies

FY91 Outlay: ¥1,209 million (FY90 Outlay: ¥1,168 million)

The promotion system for implementing new animal husbandry technologies is being updated and the implementation is being promoted through the projects listed in the table below. One of the projects is concerns the "improvement of fertilized egg supply centers," to establish the bases for propagating and enrooting the fertilized egg transplant technology which is expected to become a useful means of realizing low-cost beef production.

Project	Main Organization in Charge
Improvement of fertilized egg supply centers	Prefectural governments, federations of agricultural cooperatives and public corporations
Establishment of technology implementation, including fertilized egg transplant	Prefectural governments
Promotion of development of biotechnology implementation technology	Research Association concerning Fertilized Egg Transplant Technology for Domestic Animals
Establishment of beef cattle proliferation model bases (new technology-applied), a part of the project of developing and promoting new beef cattle production technology	Agricultural cooperatives, federations of agricultural cooperatives and public corporations

3. Regionally organized activities

A. Establishment of biotechnology implementation system through utilization of regional resources

FY91 Outlay: ¥10 million (FY90 Outlay: ¥10 million)

Through the utilization of regional technical development potential and various regional biological resources, the promotional direction for technical development will be clarified by carrying out survey research for the purpose of promoting efficient R&D and implementation of biotechnology and vitalizing regional economy.

B. Activity statuses of regional biotechnology-related organizations

Since 1984, regional biotechnology forums have been held periodically mostly at regional agricultural administration offices or regional agricultural experiment stations in each of seven regions (Tohoku, Kanto, Hokuriku, Tokai, Kinki, Chugoku-Shikoku and Kyushu) in Japan, and in these meetings, information exchange has been promoted between the industry, academia and government in each region.

Based on the results of the above activities, a research association was permanently established in the Tohoku region in FY87, and in each of the Kinki and Kyushu regions in FY91. These associations are not only sponsoring the existing forums, but also publishing trade journals, holding or introducing technical training sessions and organizing joint research projects by industry, academia and government.

Furthermore, in FY90, a permanent research association was established in the Tokai region; and a lecture meeting was held in the Hokkaido region as its preparation toward establishing a permanent organization in the region.

i. Hokkaido High-Tech Agriculture Research Association

a. Organization

Name	Sponsoring Organization (Secretariat)	Member Organization
Hokkaido High-Tech Agricultural Research Association	Hokkaido Prefectural Government (Agricultural Administration Department) Hokkaido Agricultural Experiment Station	MAFF, universities, Prefectural government, agricultural organizations, private corps.

b. Frequency of meeting

	Frequency during FY90
Lecture meeting	1
Committee meeting	1
Other	0

ii. Tohoku Regional Agriculture, Forestry, Fisheries and Food Biotechnology Research Forum (inaugurated on 24 March 1988)

a. Objectives

Biotechnology R&D and subsequent industrialization in the agriculture, forestry, fishery and food

industry will be promoted so as to develop regional economies.

b. Association memberships

Corporations and organizations:

Corporations or organizations involved in biotechnology in the fields of agriculture, forestry, fishery and the food industry

Research organizations: Universities and test and research organizations

Governments: Tohoku Regional prefectures and Tohoku Regional Agricultural Administration Office

(Note) Number of memberships, as of 1 April 1991: 228

c. Major activities

(i) Gather and disseminate biotechnology-related information (through symposium sponsorship, monthly mailing of literature and quarterly publication of Association news)

(ii) Notify members of information concerning research trainee acceptance by research organizations

(iii) Promote technical guidance and distribute information about guidance programs

d. Administration

(i) Officers: President: Kokichi Hyuga (Professor, Agricultural Department, Tohoku University

Four managers and one auditor

(ii) Secretariat: Sendai Branch Office, Noringyogyo Finance Corp.

e. Tohoku Regional Biotechnology Conferences

(i) Types of conferences, sponsors and participants

Name of Conference	Sponsorship (Secretariat)	Participant

Tohoku Regional Biotechnology Forum Livestock Committee Seedling Committee Food Industry Committee	Tohoku Regional Agricultural Administration Office (Planning & Coordination Section, except Production & Distribution Section is in charge of committee meetings) and TAES BRAIN (since FY87) Tohoku Regional Agriculture, Forestry, Fishery and Food Industry Biotechnology Research Forum (since March 1988)	MAFF; universities; prefectural governments; agricultural organizations and private corps.

(ii) Frequencies of conferences

	FY84	FY85	FY86	FY87	FY88	FY89	FY90
Forum	1	1	1	1	1	1	1
Committee meeting	3	2	3	2	3	3	3
Other	0	0	1	1	0	0	3

(Note) Tohoku Regional Agricultural Administration Office was in charge through FY87.

iii. Kanto Regional Biotechnology Forum

a. Sponsorships and participants

Name of Conference	Sponsorship (Secretariat)	Participants
Kanto Regional Biotechnology Forum	Kanto Regional Agricultural Administration Office (Agricultural Products Promotion Section, Production & Distribution Department); National Agriculture Research Center; BRAIN(since FY88)	MAFF; prefectural governments; agricultural organizations; and private corporations

b. Frequency of meeting

	FY84	FY85	FY86	FY87	FY88	FY89	FY90
Forum	1	1	1	1	1	1	1
Committee meeting	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0

iv. Hokuriku Regional Biotechnology Forum

a. Sponsorships and participants

Name of Conference	Sponsorship (Secretariat)	Participants
Hokuriku Regional Biotechnology Forum Livestock Industry Committee Food Industry Committee Plant Breeding Committee	Hokuriku Regional Agricultural Administration Office (Agricultural Products Promotion Section, Production & Distribution Department); Hokuriku AES; and BRAIN (since FT87)	MAFF; universities; prefectural governments; agricultural organizations; private corporations

b. Frequency of meeting

	FY84	FY85	FY86	FY87	FY88	FY89	FY90
Forum	1	0	0	0	0	0	0
Committee meeting	0	2	1	1	1	2	1
Other	0	0	0	0	0	0	0

v. Tokai Regional Biological Advanced Technology Research Forum

a. Objectives

Cooperative efforts will be made among the industry, academia and government for information exchange concerning advanced technology and joint research projects, in order to further promote agriculture, forestry, fishery and food-related industries.

b. Memberships

Private corporations, organizations

Private corporations and organizations involved in biotechnology in the fields of agriculture, forestry, fishery and the food industry

Research organizations

Universities, experiment stations and research institutes

Administrative organizations

Prefectural governments in Tokai Region, and Tokai Regional Agricultural Administration Office

(Note) Number of memberships (as of 14 May 1991): 360

c. Major activities

(i) Collect and disseminate advanced technology (periodical publication of journals)

(ii) Sponsor lecture meetings and seminars

(iii) Organize visits to and training sessions at experiment stations and research institutes under MAFF

(iv) Act as a liaison to organize joint research projects with and research projects consigned by MAFF-affiliated public experiment stations and research institutes

(v) Arrange fund for advanced technology development projects (subsidy, loan or investment)

(vi) Inform members of related policies and measures, and offer meeting places for groups of different industries or disciplines

d. Administration

(i) Officers:--President: Akira Yoshida (Head, Agricultural Department, Nagoya University)

Special Advisor: Setsuto Okada (Professor Emeritus, Kyoto University)

Vice Presidents (2); Trustees and Managers

(ii) Secretariat:--Tokai Branch Office, Noringyogyo Finance Corp.

e. Status of Biotechnology Tokai Regional Forum

(i) Sponsorships and participants

Name of Conference	Sponsorship (Secretariat)	Participant
Biotechnology Tokai Region Forum Crop Committee Food Committee Livestock Committee	Tokai Regional Agricultural Administration Office (Agricultural Products Promotion Section, Production & Distribution Department); NARC; BRAIN (since FY87); Tokai Regional Biological Advanced Technology Research Forum (since January 1991)	MAFF; universities; prefectural governments; agricultural organizations; and private corporations

(ii) Frequency of meeting

	FY84	FY85	FY86	FY87	FY88	FY89	FY90
Forum	1	2	1	1	1	1	0
Lecture meeting	0	0	0	0	0	0	2
Seminar	0	0	0	0	0	0	1
Other	0	0	0	0	0	0	2

(Note) Tokai Regional Agricultural Administration Office was in charge through FY89.

vi. Kinki Regional Advanced Technology Research Promotion Conference for Biotechnology in Agriculture, Forestry, Fisheries and Food Industry (abbreviated to Kinki Agri-Hightech Promotion Conference) (inaugurated on 24 May 1989)

a. Objectives

The industry, academia and government jointly promote information exchange and R&D concerning advanced technologies including biotechnology

b. Memberships

Private corporations and organizations

Private corporations and organizations involved in biotechnology in the fields of agriculture, forestry, fishery and the food industry

Research organizations

Universities, experiment stations and research institutes

Administrative organizations

Prefectural governments in Kinki Region, and Kinki Regional Agricultural Administration Office

(Note) Number of members as of 14 May 1991: 242

c. Major activities

(i) Publish and distribute magazines concerning advanced technology

(ii) Sponsor lecture meetings concerning advanced technology

(iii) Make available information concerning joint research projects between a public research institute and a private corporation

(iv) Arrange technical guidance by a university or a public research institute

(v) Disseminate funding information required for the commercialization of advanced technology

(vi) Disseminate genetic resource information

d. Administration

(i) Officers:--President: Minoru Nakajima (Professor Emeritus, Kyoto University)

Vice Presidents (3), directors and managers

(ii) Secretariat:--Kinki Branch Office, Noringyogyo Finance Corp.

e. Kinki Regional Biotechnology Forum Status

(i) Sponsorships and participants

Name of Conference	Sponsorship (Secretariat)	Participant
Kinki Regional Biotechnology Forum	Kinki Regional Agricultural Administration Office (Agricultural Products Promotion Section, Production & Distribution Department); CAES; BRAIN (since FY88); and Kinki Agri-Hightech Promotion Conference (since May 1989)	MAFF; universities; prefectural governments; agricultural organizations; and private corporations

(ii) Frequency of meeting

	FY84	FY85	FY86	FY87	FY88	FY89	FY90
Forum	1	1	1	1	1	0	0
Lecture meeting	0	0	0	0	0	1	1
Symposium	0	0	0	0	0	3	3
Other	0	0	0	0	0	1	1

(Note) Kinki Regional Agricultural Administration Office was in charge through FY88.

vii. Chugoku-Shikoku Regional Biotechnology Forum

a. Sponsorships and participants

Name of Conference	Sponsorship (Secretariat)	Participant
Chugoku-Shikoku Regional Biotechnology Forum	Chugoku-Shikoku Regional Agricultural Administration Office (Agricultural Products Promotion Section, Production & Distribution Department); CAES; SAES; and BRAIN (since FY89)	MAFF; universities; prefectural governments; agricultural organizations; and private corporations

b. Frequency of meeting

	FY85	FY86	FY87	FY88	FY89	FY90
Forum	1	2	1	0	1	1
Committee meeting	0	0	0	0	0	0
Other	0	0	0	0	0	0

(Note) In FY90, "Shikoku Sub-Regional Bio-Seminar" was inaugurated as a committee-like meeting within the region.

viii. Kyushu Regional Biotechnology Research Forum (inaugurated on 28 November 1989)

a. Objectives

The Forum will promote biotechnological approaches in agriculture, forestry, fishery and the food industry, in order to generate biotechnology R&D activities and contribute toward the advancement of agriculture, forestry, fishery and the food industry in the region.

b. Memberships

Corporations and organizations:

Corporations and organizations involved in biotechnology in the fields of agriculture, forestry, fishery and the food industry

Research institutes:

Universities, experiment stations and research institutes

Administrative organizations:

Prefectural governments in Kyushu Region and Okinawa Prefecture, and Kyushu Regional Agricultural Administration Office

(Note) Number of members as of 14 May 1990: 283

c. Major activities

(i) Collect and disseminate information concerning biotechnology

(ii) Conduct technical training sessions concerning biotechnology

(iii) Dissemination of information concerning fund acquisition required for biotechnological technical development or commercialization

(iv) Help arrange joint research projects for biotechnological technical development

d. Administration

(i) Officers:--President: Takeshi Kimura (Professor Emeritus, Kyushu University)

Advisor: Motokichi Motoe (Professor Emeritus, Kumamoto Institute of Technology)

Vice Presidents (3), directors (8) and managers (2)

(ii) Secretariat:--Kumamoto Branch Office, Noringyogyo Finance Corp.

e. Kyushu Regional Biotechnology Forum Status

(i) Sponsorships and participants

Name of Conference	Sponsorship (Secretariat)	Participant
Kyushu Regional Biotechnology Forum Crop-related seminar Food-related seminar Livestock-related seminar	Kyushu Regional Agricultural Administration Office (Planning & Coordination Office); BRAIN (since FY88); Kyushu Regional Biotechnology Research Forum (since November 1989)	MAFF; universities; prefectural governments; agricultural organizations; and private corporations

(ii) Frequency of meeting

	FY84	FY85	FY86	FY87	FY88	FY89	FY90
Forum	1	2	1	0	1	1	1
Seminar	0	0	2	1	1	0	1
Lecture meeting	0	0	0	0	0	1	1
Other	0	0	0	0	0	1	3

(Note) Kyushu Regional Agricultural Administration Office was in charge through FY88.

III-4 Promotion of Biotechnology R&D Projects through Industry-Academia-Government Cooperation

1. Promotion of biotechnology R&D through industry-academia-government cooperation

A. Rice genome analysis (new)

(FY91 through FY97) (FY90 Outlay: 0)

FY91 Outlay: ¥372 million

i. Objectives

In order to establish the basis for genetic recombination technology which makes it possible to create new farm, woodland and marine products with drastically improved productivity and quality and with much more compatibility with natural environment, the rice genome will be analyzed jointly by industry, academia and government by clarifying the entire genome picture through the analyses of the position and structure of chromosomes in the gene.

ii. Specific projects

a. Development of efficient analytical technique for rice genome and application technology for genetic molecular map (to be carried out by national research institutes)

FY91 Outlay: ¥145 million (FY90 Outlay: 0)

An efficient genome analytical technique by means of the isolation and analysis of giant DNA will

be developed; effective technologies for utilizing genetic molecule maps will be developed through the isolation and functional analysis of genes which are beneficial for agricultural production; and a method of introducing a useful gene into a specific segment will also be developed.

b. Preparation of genetic molecular map for rice genome (to be consigned to private sector)

FY91 Outlay: ¥211 million (FY90 Outlay: 0)

A detail genetic molecular map for rice genome will be prepared through the preparation of RFLP markers and the linkage analysis of genes with beneficial characteristics.

c. Preparation of basic frame for DNA bank (to be carried out by national research institutes)

FY91 Outlay: ¥15 million (FY90 Outlay: 0)

The basic frame of a system for optimally controlling and utilizing DNAs and their data will be prepared.

B. Cooperative research projects

In FY81, the cooperative research project system was inaugurated for efficiently promoting R&D concerning agriculture, forestry, fishery and related industries. In FY84, "breeding" was added as a new target field.

In FY88, the cooperative research exchange system was initiated to encourage mutual exchange of researchers and mutual use of research facilities.

(Major achievements to date)

•Development of a cell fusion technique for Rutaceae-family plants, and creation of hybrids including "oretachi"

•Development of synthetic pheromone for lawn-harming insects ((shibatsutoga) and (sujikiriyotou)).

•Creation of striped leaf disease-resistant rice through the introduction of viral genes

(Historical review of projects; as of 1 April 1991)

Field / Starting FY	Number of Projects						
	Food Processing	Breeding	Measurement	Other	Total	Active	Completed
FY82	4	-	2	1	7	-	7
FY83	9	-	2	1	12	-	12
FY84	7	2	1	1	11	-	11
FY85	10	2	2	4	18	1	17
FY86	6	6	1	-	13	1	12
FY87	7	4	1	23	35	2	33
FY88	(2) 7	2	1	(10) 25	(12) 35	-	(12) 35
FY89	(6) 8	(7) 10	(2) 2	(11) 18	(26) 38	(26) 36	2
FY90	(6) 8	(7) 10	(2) 2	(11) 18	(26) 38	(26) 36	2
Total	(8) 62	(7) 29	(2) 12	(30) 89	(47) 192	(28) 47	(19) 145

(Note) The numbers in parentheses are for exchange cooperative research projects.

C. Consignment research projects

Research projects requested by the private sector are accepted, and research projects are consigned to the private sector and universities.

D. Fluid researcher system (for terms of 1 - 3 months)

Under this system, government research institutes and experiment stations can invite researchers from or, dispatch their own researchers to, other government institutes for efficiently obtaining results. In July 1984, the system began to permit the exchange with the private sector.

2. Subsidies to private sector

For the purpose of promoting biotechnology R&D in agriculture, forestry, fishery and the food industry, it is important to aggressively take advantage of the capabilities of the private sector which is pioneering in these fields. Therefore, MAFF is providing guidance and subsidies to those private-government joint research

projects concerning the development and implementation of common key technologies in biotechnology in the fields with a high private-sector R&D potential. (A 50-percent subsidy was budgeted for each project.)

<Subsidies for R&D projects>

A. Development of plant cell transformation technology through the introduction of small intracellular organs

(FY89 through FY93) (FY90 Outlay: ¥38 million)

FY91 Outlay: ¥37 million

i. Objectives

Targeting the creation of elite crops through transformation and the production of useful substances through cellular transformation, efforts will be made to establish elemental technologies required for introducing and manifesting small intracellular organs (mitochondria and chloroplasts) and useful characters involving chromosomes.

ii. Major technical development topics

a. Development of isolation technology for small intracellular organs

b. Development of introduction technology for small intracellular organs into protoplast

c. Establishment of selection method for host protoplast

d. Development of character manifestation technology

B. Development of high-density, high-volume culture food production system through the application of super-high pressure

(FY89 through FY92) (FY90 Outlay: ¥134 million)

FY91 Outlay: ¥129 million

i. Objectives

Under super-high pressure, the enzymic activity increases, cold sterilization becomes possible and the concentration of dissolved oxygen increases. These trends all help increase productivity. Therefore, a food production system will be developed by organically integrating a super-high pressure technology (primarily sanitary) and a high-density, high-volume culture technology

(production time and productivity), in order to drastically reduce the time required for food production and to significantly increase productivity.

ii. Major technical development topics

a. Search for useful microorganisms (enzymes) that increase production (reaction) efficiency under super-high pressure (several thousand atm), and test-production of a high-density, high-volume culture device

b. Development of a super-high pressure-stable monitor system (including microbial density measuring device and dissolved oxygen analyzer) and an enzyme immobilizing carrier

c. Development and integration of control technologies including that for maintaining a super-high pressure environment

C. Development of technology to utilize an advanced bio-synthesis system for improving the efficiency of agricultural chemical production

(FY89 through FY93) (FY90 Outlay: ¥51 million)

FY91 Outlay: ¥50 million

i. Objectives

The natural bi-synthetic functions of microorganisms and plants will be effectively utilized to improve the production efficiency for agricultural chemicals. Thus, high-efficiency refining and recovery technologies for obtaining useful substances by biological reactions, and high-efficiency plant cell culture production technologies by the use of plant viral infection and proliferation functions, will be developed. Key results of these efforts will be used to efficiently produce agricultural chemicals.

ii. Major technical development topics

a. Microbial and enzymatic conversion utilization technology development

Development of efficient production technologies for agricultural chemicals by taking advantage of a microbe or an enzyme with the capability of efficiently and selectively synthesizing target chemicals.

b. High-capability plant cell utilization technology development

Development of technologies for improving the productivity of desired substances by utilizing plant cells infected by a virus or a bacterium.

c. Bio-synthesis system function improvement technology development

(i) Search for and development of production technologies for microorganisms and physiologically active components for the purpose of producing agricultural chemicals with new advantageous characteristics.

(ii) Development of bio-synthesis system function improvement technologies for efficiently producing minute quantities of physiologically active components.

D. Development of key technologies for implementing protozoan disease vaccines by genetic manipulation

(FY89 through FY93) (FY90 Outlay: ¥36 million)

FY91 Outlay: ¥35 million

i. Objectives

It has been difficult to prevent and treat protozoan diseases among livestock and domestic fowls, because the types of anti-disease chemicals and the periods during which these chemicals may be applied are restricted from the standpoint of safety. Attentions will be focused on the avian leucocytozone disease, which is a blood-parasitic protozoan disease, and a biotechnologically developed vaccine will be developed. Based on the results, key technologies will be established for implementing vaccines for other protozoan diseases.

ii. Major technical development topics

a. Study of the immunogenicity of leucocytozone protozoa

(i) Isolation, purification and identification of an immunogenic substance.

(ii) DNA analysis of the immunogenic substance.

(iii) Mass-production of the useful component by recombinant DNA technology.

b. Study of vaccine development

Test-production of a vaccine, and its laboratory and field tests.

E. Development of new hybrid breeding system in the seedling industry

(FY88 through FY92) (FY90 Outlay: ¥51 million)

FY91 Outlay: ¥51 million

i. Objectives

In an attempt to drastically improve the breeding capability for Japan's seedling industry, key breeding technologies will be developed with the establishment of an efficient breeding and seed collection system for hybrid varieties of vegetables by aggressively introducing results of advanced technologies including biotechnology.

ii. Major technical development topics

a. Accelerated cultivation technology for cytoplasmic male sterile strains by means of the asymmetric fusion method

b. Technology of creating elite characteristic species by means of cell mutation

c. Technology of introducing useful characteristics from closely-related wild varieties by means of embryo or ovule culture

d. Technology of accelerated creation of pure-line species by means of the reproductive cell system (haplont)

e. Uniform-quality mass-production system for mating pairs by mean of adventitious embryo system

F. Development of enzymatic function conversion technology in food industry

(FY87 through FY91) (FY90 Outlay: ¥100 million)

FY91 Outlay: ¥100 million

i. Objectives

Enzymatic function alteration technologies will be developed in order to be able to improve productivity and solve sanitary control problems in the food industry.

ii. Major technical development topics

a. Structural analysis of naturally occurring enzymes

b. Structural analysis of food-related enzymes

c. Design of enzymes with altered function

d. Test-production of enzymes with altered function

G. Development of technologies to alter or improve food functions (development of food design technologies)

(FY90 through FY93) (FY90 Outlay: ¥89 million)

FY91 Outlay: ¥86 million

i. Objectives

In order to produce highly nutritious and tasty quality food ingredients, practical technology (food design technology) to utilize the high production capabilities of a microorganism or a specific animal or plant cell in the food production field by applying recently rapidly advancing biotechnology.

ii. Major technical development topics

a. Development of breeding technology for food-producing microorganisms by biotechnological techniques including cell fusion

b. Establishment of multiplication technology for fused microorganisms

c. Development of cultivation, isolation and purification systems

H. Highly functional fertilizer production key technology development

(FY91 through FY95) (FY90 Outlay: 0)

FY91 Outlay: ¥49 million

i. Objectives

Requirements for fertilizers have recently diversified because of the following trends. The cost of fertilizers needs to be lowered to reduce the agricultural production cost; and interests have shifted toward high-value added and organic agriculture from environmental consideration. Particularly important is the development of highly functional fertilizers that are compatible with

the eco-system, and organic fertilizers that can improve the quality of products.

Therefore, attempts will be made to apply previous biotechnological achievements to the development of key technologies that are indispensable for the industrial production of these highly functional fertilizers.

ii. Major technical development topics

a. Development of eco-system-compatible, highly functional fertilizers

b. Development of fast fertilizer-conversion technology for good-quality organic matters by means of an efficient bio-reactor

c. Development of technologies to improve the functions of organic fertilizers, such as product quality improvement and the alleviation of harms due to consecutive planting

<Subsidies for implementation technology development projects (major new projects)>

A. Promotion of artificial seed utilization development

(FY91 through FY96) (FY90 Outlay: 0)

FY91 Outlay: ¥31 million

i. Objectives

Technologies common to the fields of seedling, chemicals and machinery will be developed in order to promote the implementation of artificial seeds which are expected to revolutionalize the development of F_1 variety seed collection technology and elite varieties.

ii. Major technical development topics

a. Mass-culture technology for adventitious embryos

b. Improvement of artificial seed capsule material

c. Automatic sealing technology for artificial seed capsules

d. Germination control technology for artificial seeds

e. Improvement of the adaptability of artificial seeds to cultivation

B. Promotion of smooth implementation of natural enemy creatures (new project), within the project to promote the diversification of insecticidal measures

(FY91 through FY94) (FY90 Outlay: 0)

FY91 Outlay: ¥18 million

i. Objectives

One of the recent issues is the measures against harmful insects not readily defended against or eliminated, such as insecticide-resistant, harmful insects. To counter these insects, many studies have been made on the biological insecticidal measures using natural enemies, and a significant number of methods have already been confirmed for their effectiveness. Outside Japan, many natural enemy insecticides are already in actual use.

However, in Japan, most of the technologies to mass-produce, formulate, store and distribute natural enemies have not yet been established. Only a few natural enemy-based formulations are registered as biological insecticides in Japan.

Therefore, attempts will be made to develop efficient mass-production and formulation technology, reliable storage and distribution technology and application (spraying) technology of effective natural enemies, and to implement biological defense measures against harmful insects.

ii. Major technical development topics

a. Development of mass-proliferation technology for effective natural enemies

b. Development of efficient formulation technology

c. Development of reliable storage and distribution technology

d. Development of effective application (spraying) technology

C. Development of environment-friendly food packaging technology (new project)

(FY91 through FY94) (FY90 Outlay: 0)

FY91 Outlay: ¥115 million

i. Objectives

In order to reduce wastes from and promote recycling of food packaging materials and containers without sacrificing their functions (including safety aspects), attempts will be made to develop environment-friendly (less environment-taxing) food packaging technology including bio-degradable

plastics.

ii. Major technical development topics

a. Development of environment-compatible packaging materials and containers

b. Development of re-use technology for packaging materials and containers

c. Development of evaluation technology for satisfactory food packaging materials and containers

D. Promotion of livestock biotechnology implementation technology development (new project)

(FY91 through FY95) (FY90 Outlay: 0)

FY91 Outlay: ¥64 million

i. Description

Efforts will be made to promote the development of new technologies based on the transplantation technology of fertilized eggs for livestock, particularly, basic technologies for nuclear transplantation, and the development of drug chemicals and instruments necessary for the procedure. Therefore, MAFF will subsidize the acquisition and maintenance of machines and the purchase of research materials required for the project render advice and guidance concerning technical R&D through national research institutes, and carry out on-site surveys on related technologies overseas.

ii. Major technical development topics

a. Nuclear inactivation technology for in-vitro matured eggs

b. Cell fusion technology

c. Freeze-preservation technology for porcine fertilized eggs

d. New parentage (individual) identification technology

E. Development of biotechnology-applied fish farm systems (new project)

(FY91 through FY95) (FY90 Outlay: 0)

FY91 Outlay: ¥17 million

i. Objectives

Fish farming has become increasingly important and its productivity needs to be improved in view of the recent 200-nautical mile fishing area limitation. Due to the recent progress in biotechnology, it has become possible, in a laboratory, to produce three-times larger fish that maintain a high growth rate by not maturing, and to produce only the female fish which have a higher market value than the male counterpart. Thus, attempts will be made to develop methods to introduce these laboratory techniques into the fish farming industry, and to propagate biotechnological seeds.

ii. Major technical development topics

a. Development of mass-production technology for biotechnologically produced fish

Scale up laboratory technologies to mass-produce seeds for fish farms.

b. Creation and preservation of elite clone fish

Clone fish will be created to possess elite characteristics including fast growth rate, high value and disease resistance, and the fish will be stored constantly at a specific place to be supplied as seeds whenever necessary.

c. Compilation of manuals for cultivating biotechnologically produced fish

The cultivation method suitable for the characteristics of a particular biotechnologically produced fish will be examined, and the results will be compiled in a manual.

F. Countermeasures against oil pollution damages in fishing grounds:

Development of biological cleaning technology for oil pollution (new project), within the oil-pollution damage prevention measure project

(FY91 through FY95) (FY90 Outlay: 0)

FY91 Outlay: ¥9 million

i. Objectives

Oil pollution in fishing grounds not only cause fishing losses, but also adversely affect the eco-systems and the reproduction function of the fishing grounds.

Considerable amounts of time and labor will be required to completely restore oil-polluted fishing

grounds. Through the development of a oil pollution treatment technology using an oil-decomposing microorganism, the polluting oil will be quickly and safely removed and the fishing ground environment will be rapidly restored. Therefore, basic technologies necessary for the new technology development will be studied.

ii. Major technical development topics

a. Naturally occurring oil-degrading microorganisms will be collected, isolated, cultivated and evaluated for their capabilities.

b. The R&D statuses, in Japan as well as overseas, of "microbial formulations" or "nutritional formulations," which are considered to be applicable for cleaning oil pollution, will be surveyed and evaluated by testing.

c. The relationships of oil-degrading microorganisms with, and their effects upon marine biological resources (eco-systems) will be surveyed and compiled.

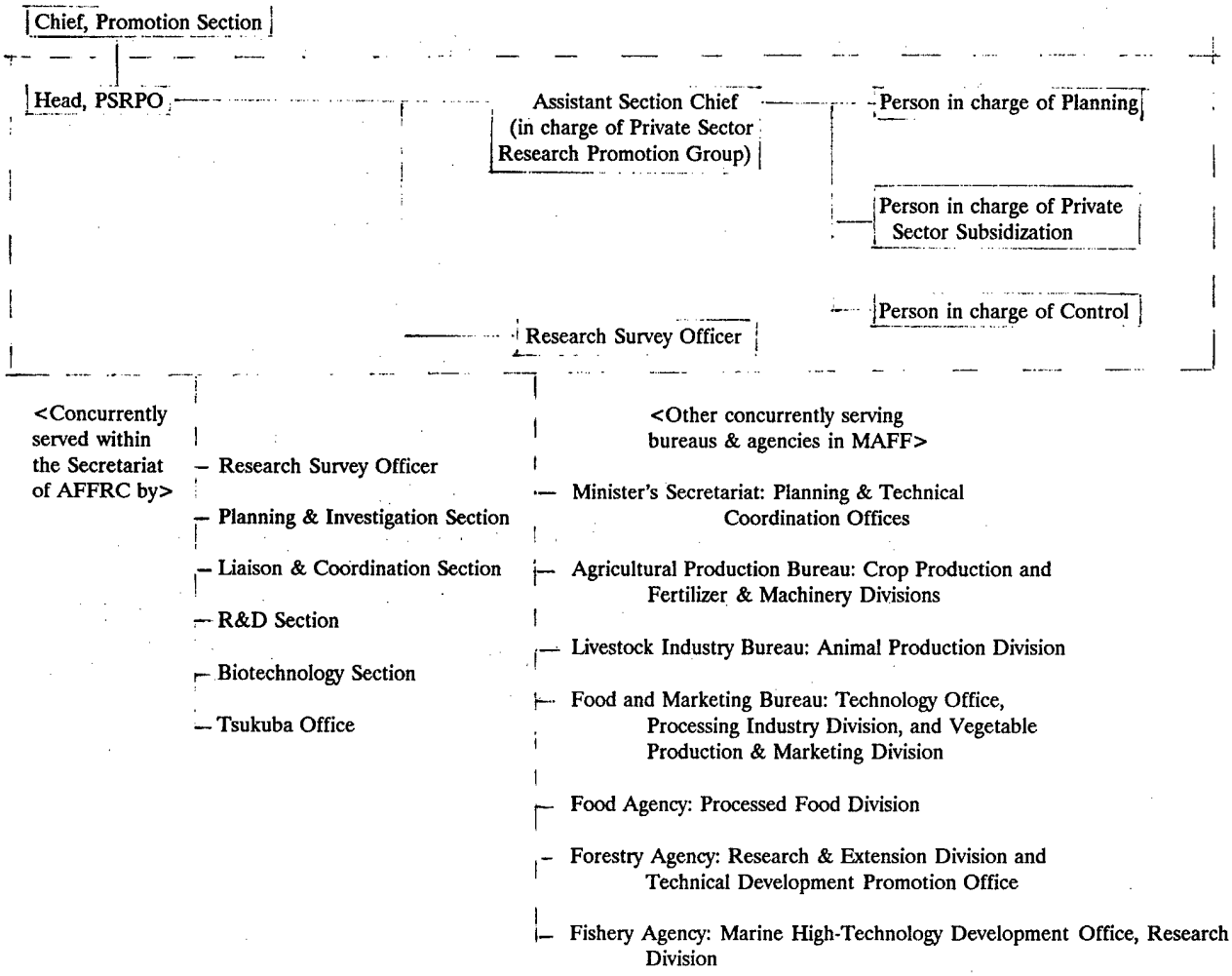
d. The compilation of evaluation standards (manuals) concerning the treatment technologies by oil-degrading microorganisms will be examined.

e. Subsidy recipient: Fishery Oil-Pollution Relief Foundation, Inc.

3. Establishment of Private Sector Research Promotion Office

On 11 June 1990, the Private Sector Research Promotion Office (PSRPO) was established within the Promotion Section of the Secretariat of the Agriculture, Forestry and Fisheries Research Council (AFFRC), in order to support and promote private-sector tests and research projects using advanced technologies, such as biotechnology and electronics, for agriculture, forestry, fishery and the food industry.

<Organization of PSRPO>



4. Other Promotional Policies

A. Duties of BRAIN

BRAIN shall fund or give loans to testing and research projects concerning bio-oriented technologies including biotechnology in the private sector (initial targets will be technologies concerning agriculture, forestry and fishery; beverage and food production industry; tobacco production industry; silk-reeling industry; lumber production industry; sales of agricultural, forestry and marine products and beverages and foods; and tobacco sales).

FY91 Outlay: ¥2,200 million (FY90 Outlay: ¥1,900 million)

i. Funding Projects

BRAIN shall purchase stocks of joint bio-oriented technical development corporations (that pay stock dividends) which have been jointly established by two or more corporations, organization in the fields of agriculture, forestry and fishery, and local public organizations.

(a) Investment ratio

Investment of up to 70 percent of the fund necessary for a project (except land cost)

(b) Investment period

As a rule, not more than seven years (if deemed necessary, not more than 10 years)

ii. Loan Projects

FY91 Outlay: ¥1,300 million (FY90 Outlay: ¥1,600 million)

BRAIN shall issue loans, under the conditions stipulated below, to a corporation, an organization in the fields of agriculture, forestry and fishery, or a public-service corporation for its research and testing projects concerning bio-oriented specific industrial technologies.

(a) Loan ratio: Not more than 70 percent of loan target costs (including facility and equipment, testing ground development, material, commodity, labor, overseas procurement and miscellaneous costs).

(b) Term of loan: Until the project termination or not more than five years, as a rule.

(c) Repayment term: Not more than 15 years, as a rule.

(d) Interest: Conditional zero interest. (In the case of a successful completion of a project, an interest corresponding to the degree of the success shall be paid back.)

(e) Reward: Corresponding to the interest calculated at simple interest rate per annum for the entire loan term, with the said interest rate being commensurate to the degree of the success.

(f) Collateral & guarantor: Required as a rule.

iii. Recommend joint research projects between a private corp. and a national research institute

iv. Recommend or advise on the offering of plants' genetic resources by the "Agriculture, Forestry and Fisheries Gene Bank" to private corporations

v. Invite foreign researchers, accept research projects as a consignee, disseminate information and

carry out surveys

<Summary of Projects Funded by BRAIN>

(a) FY86 Projects

Corporation	Project Title	Major Investing Corporations	
Hokkaido Green-Bio Research Institute, Inc.	Biotechnological R&D concerning cold-resistant plant resources	•Hokuren Agricultural Cooperative Federation •Hokkaido Credit Agricultural Cooperative Federation •Hokkaido Welfare Agricultural Cooperative Federation •Hokkaido Prefecture •Hokkaido Electric Power Co., Ltd.	•Hokkaido Agricultural Cooperative Central Association •Hokkaido Mutual Aid Agricultural Cooperative Federation •Hokkaido Takushoku Bank, Ltd. •Hokkaido Bank Additional two foundations
Okinoerabu Bulb Bio Research Institute, Inc.	Research concerning biotechnological breeding and mass, accelerated cultivation of flowering bulbs	•Wadomari Town •China Town •Nan-ei Sugar Co., Ltd. •Kyowa Hakko Kogyo Co., Ltd.	•Wadomari Agricultural Cooperative •China Agricultural Cooperative •Erabu Lily & Freesia Production & Shipping Association
Nursery Technology, Inc.	R&D concerning mass proliferation system for seedlings	•Kirin Brewery Co., Ltd. •Japan Steel Corp. •Hiroshima Prefecture Economic Agricultural Cooperative Federation •Saga Prefecture Economic Agricultural Cooperative Federation	•Kyowa Hakko Kogyo Co., Ltd. •Taisei Corp.
Iwate Biomass Research Center, Inc.	Research concerning effective conversion of cellulosic biomass into animal feeds	•Hitachi Zosen Corp. •Japan Steel Corp. •Iwate Prefecture Economic Agricultural Cooperative Federation	•Koiwai Stock Farming Co., Ltd. •Iwate Prefecture
Zymurgic Resource Research Institute	R&D concerning genetic resources for zymurgic microorganisms	•Asahi Breweries, Ltd. •Kyowa Hakko Kogyo Co., Ltd. •Gekkeikan Corp. •Suntory Ltd. •Takara Shuzo Co., Ltd. •Nikka Whiskey Co., Ltd. •Brewing Society of Japan	•Ozeki Shuzo Co., Ltd. •Kirin Brewery Co., Ltd. •Sapporo Breweries, Ltd. •Sanraku Breweries, Ltd. •Tohojozo Co., Ltd. •Hakutsuru Shuzo Co., Ltd.
Marine Seedling Development Center, Inc.	R&D concerning biological feeds for fish farming	•Nissin Oil Mills Co., Ltd.	•Mitsui Marine Development Co., Ltd.
Sea-Tex Corp.	R&D concerning farm system for to-be-developed high-value fish	•Mitsubishi Mining & Cement Co., Ltd. •Taiyo Fishery Co., Ltd. •Takashima Town	•Mitsubishi Coal Mining Co., Ltd. •Nagasaki Prefecture 11 other corporations of the Mitsubishi Family of companies

(b) FY87 Projects

Corporation	Project Title	Major Investing Corporations	
Processing Rice Breeding Research Institute, Inc.	Research concerning development of rice variety suitable for processing	•Japan Tobacco Industry Corp. •Kirin Brewery Co., Ltd. •Tokyo Electric Power Co., Ltd.	•Brewery Society of Japan •Tokyo Prefecture Sake Makers' Association •Japan Grain Sanction Association
Green Environment Resource Development Center, Inc.	Research concerning creation of indoor-growing trees and establishment of hydro-culture system	•Hitachi Zosen Co., Ltd. •Ube Industries, Ltd. •Sanwa Bank, Ltd. •Kurogane Kosakusho Ltd. •Daisue Construction Co., Ltd. •Nissho-Iwai Corp.	•Ohbayashi Corp. •Fujisawa Pharmaceutical Co., Ltd. •Osaka Cement Co., Ltd. •Zenitaka Corp. •Toyo Construction Co., Ltd. •Uchiyama Green-Land Construction Co., Ltd.
N T Science, Inc.	Research concerning biotechnological production of elite animals for experiments	•Nisseiken Inc.	•Tosoh Corp.

(c) FY88 Projects

Corporation	Project	Major Investing Corporations	
Japan Turf Grass Corp.	Research concerning development of breeding and new proliferation technologies for lawn grass	•Japan Horse-Racing Facility, Inc. •Nihon Noyaku Co., Ltd.	•Taisei Corp. •Toyo Green Co., Ltd.
Gifu Immunity Research Institute, Inc.	Research concerning development of immunity formulations for livestock contagious diseases	•Gen Corp. •Kyoritsu Organic Industry Research Institute, Inc.	
Wakayama Agri-Bio Research Center, Inc.	Research concerning development of improved microbial production technology for tangerine juice	•Wakayama Prefecture Agricultural Cooperative Federation •Asahi Breweries, Ltd.	•Toyo Seikan Kaisha, Ltd. •Wakayama Nokyo Food Corp. •Wakayama Prefecture Agricultural Product Processing Research Institute
Cold-Water High-Value Fish Farming Technology Research Institute, Inc.	Research concerning breeding of better cold-water high-value fish and new farming system	•Nippon Suisan Kaisha, Ltd. •Iwate Prefecture Fishery Cooperative Federation	•Nichimo Co., Ltd. •Nissan Construction Co., Ltd. •Japan Steel Corp.

(d)FY89 Projects

Corporation	Project Title	Major Investing Corporations	
Techno-Grafting Research Institute, Inc.	Development of mass-production technology for elite graft-tree seedlings	•Japan Tobacco Industry, Inc. •Toshiba Corp. •National Federation of Agricultural Cooperatives	•Komatsu Ltd. •Kajima Corp.
Crop Growth Control System Research Association, Inc.	Development of farming robots and precision control system suitable for crop physiology	•Kubota, Ltd.	•Ikegami Tsushinki Co., Ltd.
Functional Peptide Research Institute, Inc.	Development of known-component, serum-less culture for livestock ova	•Bio-Science Research Institute, Inc. •Yamagata Shimbun Co., Ltd. •Intelligent Cosmos Research Organization, Inc.	•Livestock Improvement Corp. •Tohoku Electric Power Co., Ltd. Six additional corporations
Nematic Corp.	Development of anti-nematode technology by means of natural enemy organism	•Hodogaya Chemical Co., Ltd.	•Sankei Chemical Co., Ltd.
Nondestructive Fruit Quality Evaluation Research Institute, Inc.	Development of automatic, nondestructive classification system for fruits	•Maki Manufacturing Co., Ltd. •Ehime Prefecture Fresh Fruit Agricultural Cooperative Federation	•Hamamatsu Photonics Corp.

(e) FY90 Projects

Corporation	Project Title	Major Investing Corporations	
Okinawa Orchid Research Institute, Inc.	Technical development concerning cultivation of new Orchidaceae varieties	•Orion Beer Co., Ltd. •Okinawa Electric Power Co., Ltd. •Gushikawa City •[Okinawa Prefecture Economic Federation]	•Takakura Corp. •Tropical Resource Plant Research Institute, Ltd. •Okinawa Bank, Ltd. •[Okinawa Prefecture]
Feed Crop Breeding & Proliferation Technology Research Institute, Inc.	Development of seed production technology in F_1 breeding of feed crops	•Japan Feed Crop Seed Association •Snow Brand Seedling Co., Ltd. •[Hokuren Agricultural Cooperative Federation]	•Takii & Co., Ltd. •Livestock Technology Association, Inc.

Glyco-Chain Engineering Research Institute, Inc.	Glyco-biological research for development of useful saccharides	•Takara Shuzo Co., Ltd. •Kaken Pharmaceutical Co., Ltd. •Seikagaku Kogyo Co., Ltd. •Intelligent Corp. •Shibata Medical Science Corp. •Aomori Bank, Ltd. •[Aomori Prefecture]	•Chugai Pharmaceutical Co., Ltd. •Kanesa Corp. •Tohoku Kagaku Pharmaceutical Co., Ltd. •Cosmos Research Organization •Tohoku Electric Power Co., Ltd. •Michinoku Bank, Ltd. •[Hirosaki City]
Seaweed Resource Research Institute, Inc.	Technical development of component utilization and high-density cultivation for Southern-region seaweeds	•Yamaki Corp. •Nissan Construction Co., Ltd. •Iyo Bank, Ltd. •[Ehime Prefecture Fishery Cooperative Federation •[Ehime Prefecture] •[Iyo City]	•Marutomo Corp. •Nissen Kagaku Kogyo Co., Ltd. •Sumitomo Chemical Co., Ltd. •[Ehime Prefecture Credit Fishery Cooperative Federation]

[ ] denotes "pending."

<Total Number of Funded and Financed (Loan) Projects>

Field	Funded Project	Financed Project
Breeding and cultivation of farm crops	8	21
Agricultural chemicals and building materials	1	6
Facilities and machinery	2	3
Livestock	5	13
Food and brewery industries	3	27
Forestry	-	5
Fisheries	4	13
Total	23	88

B. Revision of financing and tax systems for promoting R&D and industrialization

i. Financing (loan) systems

Since FY88 the following financing systems have been revised to include biotechnology-related facilities.

System	Loan Target	Loan Recipient	Interest Rate	Maximum Loan Rate	Term of Redemption	Remark
Agriculture Improvement Fund	Biotechnological facilities (creation and proliferation of virus-free seedlings)	Farmers	Interest free	80 percent	Within five years	

Agriculture, Forestry & Fishery Finance Corp. Fund	Common facilities for biotechnological production of agricultural, forestry, animal and marine products Experiment and research facilities for new variety cultivation	Farmers, woodsmen and fishermen Incorporated organizations (including corporations) organized by farmers, woodsmen and fishermen	6.6 percent 6.6 percent	80 percent 80 percent	Within 20 years (including three years of deferment period) Within 15 years (including three years of deferment period)	Common use facilities financed by the Agriculture, Forestry and Fishery Facility Fund Competent minister-designated facilities financed by the Agriculture, Forestry and Fishery Facility Fund
Japan Development Bank Fund	Facilities and equipment required for biotechnological production of beverages, foods, fats and oils, or materials exclusively used for agriculture, forestry, livestock and fishery	Private or public service corporations	6.8 percent	40 percent	Within 15 years (including three years of deferment period)	Facilities and equipment, as described in left, will be added to the list of loan targets under the sub-heading "Promotion of Biotechnology Industrialization."
Hokkaido-Tohoku Development Fiance Corp. Fund	Same as above	Same as above	6.8 percent	70 percent	Within 15 years (including three years of deferment period)	Establish the new "Regional Biotechnology Commercialization Promotion" provision in the Special Interest System

Note: The interest rates shown were effective as of 1 June 1991.

ii. Tax measures

In order to encourage biotechnology R&D in the private sector, the exception provision was made for the national tax (corporate income) for three years starting in FY85, and for the local tax (fixed property tax) for two years starting in FY86. These terms were extended by the tax revision systems in FY88 and FY90.

a. National tax

When an individual or a corporation, which submits a business income statement, has acquired, manufactured or constructed key technology R&D machines or facilities between 1 April 1988 and 31 March 1993, a sum corresponding to seven percent of the cost, in addition to the deductible additional experiment and research expenses, shall be deducted from the corporate income tax (the total deduction not to exceed 15 percent of the tax without deduction).

<Covered machines and facilities>

Genetic recombination laboratory, safety cabinet for research, high-pressure sterilizer for research,

automatic colony transfer device for research, cell and tissue culture experiment device, cell fusion experiment device, cell classification experiment device, cell microscopic manipulation device, bioreactor experiment device, peptide purification experiment device, peptide auto-slicer, peptide synthesizer, amino acid analyzer, immunity measurement device, electronmicroscope, supersonic microscope, spectroscopic analyzer, x-ray analyzer, mass spectrometer, nuclear magnetic resonance absorption device, and super-critical separation experiment facility

<Addition to the above, as of 1 October 1987>

Centrifuge for microbial and cellular metabolic materials, microbe and cell culture conditioning device, plant assimilation device, laser injector for genes, nucleic acid auto-extractor, and nucleic acid base sequence analyzer

<Addition to the above, as of 1 April 1990>

Auto-amplifier for nucleic acids, and intracellular calcium concentration analyzer

b. Local tax

The fixed asset tax assessment for the research machines or facilities which have been newly acquired, manufactured or constructed for steadily promoting research experiments concerning genetic recombination technology and its application technologies during the period from 1 April 1985 to 31 March 1991, will be reduced to two thirds of the regular assessments only for the three fiscal years starting with the fiscal year in which the said tax is assessed for the first time.

<Covered machines and facilities>

Ventilating device and ultraviolet radiation device for genetic recombination laboratory, safety research cabinet, high-pressure research sterilizer, closed bioreactor experiment device, nucleic acid purification experiment device, peptide purification experiment device, and peptide automatic slicer.

<Addition to the above, as of 1 April 1990>

Closed-type centrifuge for microbial and cellular metabolic substances, closed-type plant assimilation device, and nucleic acid base sequence analyzer.

<Addition to the above, as of 1 April 1990>

Nucleic acid automatic amplifier

(Other Related Tax Systems)

•Mining & Industrial Technical Research Association

a. National tax (continuation)

The Mining Industry Technical Research Association assesses its corporate member a share for either acquiring or manufacturing machinery and equipment required for research experiments. If the charged share is to be paid by 31 March 1993, the corporation may voluntarily depreciate that amount, and may in advance write off the cumulatively acquired research asset value, rounded off to ¥1.00.

b. Local tax (extension of applicable term)

Those machines and devices that have been approved in accordance with the stipulation in Article 14 of the Mining Industry Technical Research Cooperative Law, and that have been acquired or manufactured by 31 March 1991, shall be taxable as fixed assets at a rate four fifths of the standard assessment rate for the three fiscal years beginning with the fiscal year in which the said tax is first levied.

•Bio-Oriented Technology Research Advancement Institute (BRAIN) (newly established in FY88)

When a private corporation invests through BRAIN for a specific experimenting or research corporation, the amount equivalent to 20 percent of the investment, under certain conditions, can be added to the investing company's increased research expenses to be specially deducted from the corporation's income tax.

III-5 Promotion of Basic Research Projects through Cooperation with Universities

Biotechnology Advanced Technology Seed Cultivation Research Projects

In FY84, the biotechnology seed cultivation research projects were initiated through consignment to universities capable of advanced basic and interdisciplinary studies in order to cultivate and nurture seeds (germinations) that were expected to become the basis for future technical development in the rapidly advancing

biotechnological field.

FY91 Outlay: ¥103 million (FY90 Outlay: ¥103 million)

Research Project	Specific Research Topics
I. Clarification of mechanism for high-order information manifestation by plant nuclear chromosomes 1. Clarification of high-order control function in genetic recombination and manifestation in plants 2. Elucidation at molecular level of function and structure of plant chromosomes 3. Clarification of plant cell functions for chromosomal manipulation Project leader: Tadashi Watanabe (professor emeritus, Keio University) Project term: FY89 through FT93	(1) Molecular clarification of gene insertion mechanism into chromosome (2) Clarification of mutation mechanism of plant chromosome caused by transpositional factors (3) Clarification of high-order control function of plant genetic manifestation (4) Clarification of stabilized functional segment in plant chromosomes (5) Basic study of plant recombination technology using artificial chromosomes (6) Molecular clarification of unique structure in meiosis of plant cells (7) Clarification of high-order information manifestation of cytoplasmic inheritance (8) Clarification of stability of mini-protoplast-inserted chromosomes
II. Basic studies concerning development of chemomimetic enzymatic reaction systems 1. Alteration of substrate specificity by chemomimetic reaction 2. Introduction of enzymatic function into specific biopolymer 3. Development of high-function enzymes through combination of chemomimetic and protein engineering techniques Project leader: Shuichi Suzuki (Professor, Saitama Institute of Technology) Project term: FY90 through FY94	(1) Alteration of reaction characteristics and substrate specificity of glucoamylase (2) Widening and narrowing of substrate group specificity in proteases (3) Design and synthesis of RNA enzymes (4) Clarification of basic techniques for creating antibody enzymes (5) Creation of novel enzymes by introducing unnatural amino acids (6) Design and characteristics of artificial dimer enzyme models (7) Alteration of enzymatic functions of lipase by chemomimetic technique
III. Clarification of animal genes 1. Structural analysis of genes involved in beneficial characters of livestock animals and clarification of manifestation mechanisms 2. Clarification of marine organism genes involved in substance production and metabolic mechanisms, and clarification of the manifestation mechanisms of the genes Project leader: Kazuya Yamauchi (Professor, Medical Research Institute, Tokyo University) Research term: FY88 through FY92	(1) Basic studies concerning animal viral DNA manipulation technology (2) Genetic manifestation mechanisms of transformed animal through genetic introduction into young embryos (3) Clarification of function-manifestation mechanisms of immunity cells with reconstructed genes (4) Clarification of structure and functions of major histo-compatible genes (5) Clarification of histo-specific manifestation dominance region for animal genes and enhancers (6) Development of cloning vectors for long DNA segments (in the order of 500-kb) (7) Clarification of physiologically active substance production mechanisms of marine organisms (8) Analysis of genes involved in metabolic products and their accumulation mechanisms in marine organisms (9) Clarification of control mechanisms for growth of marine organisms (10) Basic studies for marine organism vector system development

Note: The above table includes only the projects involving Japanese researchers. The projects consigned to overseas organizations are discussed under "III-6. Current Status of International Research Exchange."

III-6. Current Status of International Research Exchange

1. International exchange of post-doctorate researchers

Post-doctorate researchers of developing nations will be invited to Japan specifically to carry out joint research projects primarily concerning the recombinant DNA technology and to contribute to research cooperation with these nations. This system was inaugurated in FY88 (two researchers for five months).

One researcher each from Thailand and Malaysia in FY88, one each from Thailand and Philippines in FT89, and one each from Thailand and Indonesia in FY90 were invited to the National Institute of Agrobiological Resources (NIAR).

2. Research cooperation based on two-nation science and technology cooperation agreements

Many cooperative research projects are being carried out in the fields of agriculture, forestry and fishery, in particular the biotechnology fields in recent years, based on the two-nation science and technology cooperation agreement. In May 1990, joint research project titles were agreed upon by Japan and the U.S. in various life science fields at the high-level joint committee, in accordance with the June 1988 agreement with the U.S. which was one of the two-nation science and technology cooperation agreements.

In addition, biotechnology workshops have been frequently held under the sponsorship of an international organization, such as FAO and CGIAR. Many Japanese researchers have participated in these workshops.

3. Advanced technology international joint research

Joint research projects and workshops with researchers of the industrialized nations of Europe and America are planned for efficiently promoting basic research in biotechnology.

A. International joint research projects

i. Researcher(s) will be sent to the U.S. for a long term (FY89 through FY91) to participate in the project, "Research concerning the analysis of cis-trans components involved in genetic manifestation by high-order plants."

ii. Researcher(s) will be invited from the U.S. for a long term (FY90 through FY92) to participate in the project, "Research concerning the clarification of the nerve-system differentiation mechanism of insects during their embryo development process."

B. International workshops

"Clarification of the inter-microbial antagonistic actions in the farm eco-system" (FY90 topic)

4. Overseas-consigned leading brain-concentrated seed cultivation research

FY91 Outlay: ¥15 million (FY90 Outlay: ¥15 million)

In order to elevate the biotechnology research standard in Japan, new research projects will be initiated under the heading of "Overseas-consigned leading brain-concentrated seed cultivation research," for consignment to foreign universities. These projects will carry the most advanced topics which are hardly pursued within Japan.

•Research project title: "Basic studies concerning the development of beneficial transgenic large livestock" (FY90 through FY92)

5. Research exchange

In accordance with the system of the Science and Technology Agency (STA), the exchange of researchers in the biotechnology fields is underway; i.e., Japanese researchers are sent to research institutes in other nations and to attend international research meetings, while researchers of other nations are invited to Japan.

III-7. Strengthening of Promotion Basis

1. Biotechnological personnel training

A. Research trainee system

Researchers from the prefectural governments and the private sector are invited to national government research institutes for two to six months to receive guidance in research experiments. In FY84, a biotechnology slot was newly created to provide guidance in this field. In FY88, a new exclusive research trainee course (nine-month course) was established to strengthen the government's acceptance system.

•Status of trainee acceptance (biotechnology field only)

Fiscal Year	Total Number of Trainees		
		Trainees from Private Sector	Trainees from Prefectures
FY84	51	14	37
FY85	80	19	61
FY86	88	11	77
FY87	76	18	58
FY88	67	28	39
FY89	62	22	40
FY90	71	25	46

B. Short group training session for prefectural researchers in agriculture, forestry and fishery

Short-term training sessions are held specifically for prefectural researchers to systematically acquire the newest high-level research theories, research methodology and research accomplishments.

•Past training sessions (biotechnology field only)

Fiscal Year	Dates	Training Topic	Number of Participants
FY84	17 - 22 December 1984	•Biotechnological techniques useful at experiment and research institutes in agriculture, forestry and fishery	75
	25 - 30 March 1985	•Biotechnological techniques useful at experiment and research institutes in agriculture, forestry and fishery	57
FY85	20 - 22 January 1986	•Breeding technology with culture system	52
FY86	9 - 12 March 1987	•Biotechnological techniques useful at experiment and research institutes in agriculture, forestry and fishery	50
FY87	14 - 18 March 1988	•Biotechnological techniques useful at experiment and research institutes in agriculture, forestry and fishery	53
FY88	23 - 27 January 1989	•Biotechnological techniques useful at experiment and research institutes in agriculture, forestry and fishery	51
FY89	4 - 8 December 1989	•Biotechnological techniques useful at experiment and research institutes in agriculture, forestry and fishery Plant fields Animal fields	 36 22
FY90	22 - 26 October 1990	•Biotechnological techniques useful at experiment and research institutes in agriculture, forestry and fishery Plant fields Animal fields	 28 17

C. In-service training for national government researchers

i. Training systems within Japan

(a) MAFF-administered system

Researchers will be dispatched to universities, experiment and research institutes under the jurisdiction of ministries other than MAFF and agencies and experiment and research institutes other than that the researchers are affiliated with, under the jurisdiction of MAFF (for a period of two months to one year).

(b) STA-administered system

Researchers will be dispatched to national universities and national university-sharing institutes in natural sciences (for a period of not more than one year).

ii. Training systems overseas

(a) STA-administered, long-term overseas studying system for researchers (one year)

(b) STA-administered, partially guaranteed researcher dispatch system (six months to one year)

(c) MAFF-administered, totally guaranteed researcher dispatch system (six months to one year)

iii. Biotechnology training for MAFF researchers

MAFF researchers are given opportunities to systematically acquire the latest research theories and methodology in biotechnology.

•Previous training activities

	FY86 (20 days)	FY87 (3 to 6 months)	FY88 (3 to 6 months)	FY89 (2 to 6 months)	FY90 (3 to 6 months)
Gene manipulation training course	4	4	5	7	5
Cell manipulation training course	16	5	3	1	2

iv. Genetic engineer training

Trainees will be taught overall knowledge and techniques of biotechnology with an emphasis on DNA manipulation. This system was initiated in FY88.

In FY89, from 4 to 14 December 1990, a curriculum including on-site training was offered at NIAR.

2. Storage and control of genetic resources

A. Status of genetic resource preservation by MAFF

i. Status of genetic resource preservation

MAFF preserves 170,000 plant genetic resources at NIAR. In addition, MAFF preserves approximately 11,000 microbes, approximately 21,000 trees, 630 animals and 290 marine organisms for research experiment uses (Table 1).

ii. Updating of gene banks for agriculture, forestry and fishery

Various genetic resources need to be integrally secured as the bases for successful development of biotechnology. Therefore, in FY85, MAFF began to make efforts to collect and strengthen control of information concerning genetic resources and genetic breeding, by integrally updating the control and application system (the gene bank for agriculture, forestry and fishery) with respect to the entire products of agriculture, forestry and fishery including plants, animals, microorganisms, trees (initiated in FY87) and marine organisms (Table 2).

In response to the private sector's demand for the distribution of these resources, MAFF began

to distribute plant genetic resources in January 1986, and microbial genetic resources in September 1987 for research experiment purposes (Table 3).

B. Plant genetic resource preservation status at major overseas organizations

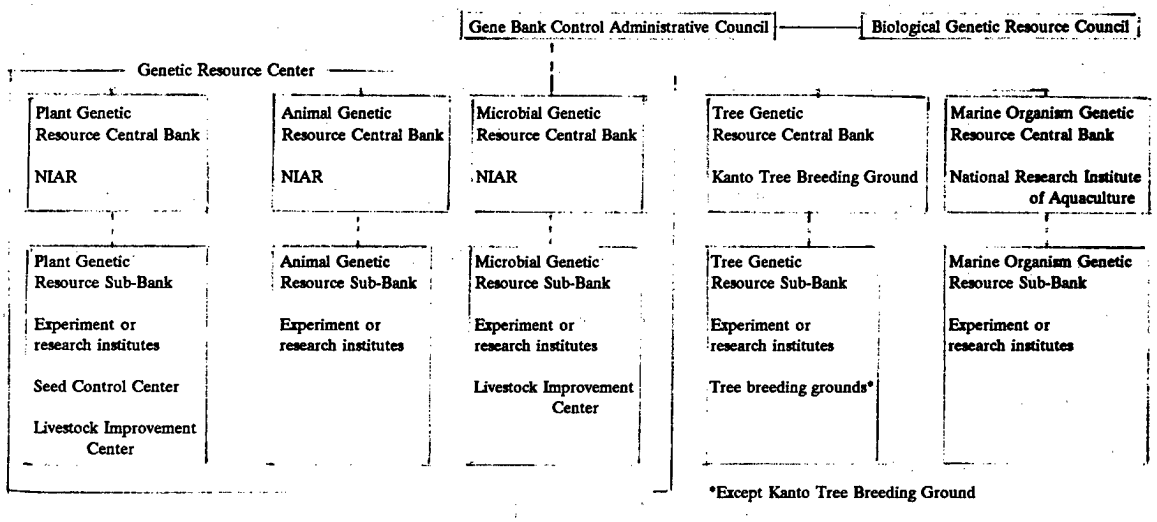
Both the U.S. and U.S.S.R. have long made efforts to preserve plant genetic resources for agricultural promotion. Today, approximately 400,000 items are being preserved at the U.S.S.R. Plant Production Research Institute, and approximately 200,000 items are being stored at the U.S. National Seed Storage Research Institute.

A plan is being made to form a preservation network for all of these preserved items with the base at IBPGR (International Board of Plant Genetic Resources) (Table 4).

(Table 1) Collection and Preservation Plan and Current Status (as of the end of February 1989; the goals to be reached in FY92)

Classification	Plant	Animal	Microbe	Tree	Marine Organism
Current	170,000	630	11,000	21,000	290
Goal	230,000	710	13,000	25,000	2,100

(Table 2) Organization Chart for MAFF Gene Bank Administration



(Table 3) Distribution Record

	National Research Institutes	Public Research Institutes	Universities	Private Sector & Other	Overseas	Total
Plants	36,937	792	3,305	2,389	4,561	47,984
Microbes	651	76	480	586	11	1,804

(Note) The above numbers include the plant items distributed from 25 January 1986, when the plant distribution regulations were established, and the microbe items distributed from 1 September 1987, when the microbe distribution regulations were established, through the end of March 1991.

(Table 4) Preservation Status of Plant Genetic Resources at Research Institutes in Japan and Overseas

Institute (National)	Total Number of Preserved Items (in thousand)	Major Crop
[U.S.A.][*1]	433	
National Seed Storage Research Institute	205	Wheat, soybean and rice
Plant Genetic Germ Plasm Research Institute	108	Wheat, soybean and oats
Three other facilities	120	
[U.S.S.R.][*2]		
Soviet Union Plant Production Research Institute	400	Wheat, barley and legumes
[P.R.C.][*3]		
Chinese Crop Genetic Resource Storage Center	300	Rice, wheat and sorghum
[U.K.][*4]		
Plant Breeding Research Institute	63	Wheat, barley and oats
[Japan][*5]	173	
NIAR	104	Rice, wheat, barley and legumes
Vegetable, Crops and Tea Research Station	17	Melons, eggplant, tomatoes and teas
Fruit Tree Research Station	5	Apples, citrus fruits and grapes
Others	47	
[International Institutes][*6]		
International Rice Research Institute (IRRI)	84	Rice
International Wheat, Corn Improvement Center (CIMMYT)	50	Wheat, barley and corn
International Semi-Arid Tropical Crop Research Institute (ICRISAT)	85	Legumes, sorghum and millet

Information sources: [*1] Diversity No. 10 (1987); [*2] "Information exchange concerning collection, maintenance and utilization of crop genetic resources for breeding" (Nakagawara and Sanada (1988)); [*3] Chugoku Tsushin by Shinka Co., Ltd., (Nippon Nogyo Shimbun, 10 September 1984); [*4] National Institute of Resources, Science and Technology Agency (1984); [*5] Survey by Liaison & Coordination Division, Agriculture, Forestry and Fishery Research Council (1991); [*6] "Maintenance of genetic resources for breeding" (Suzuki (1988)), except for IRRI which was taken from "Survey report on tropical agriculture research and promotion" (Saito (1988)).

3. Operation of Tsukuba Agriculture and Forestry Research Exchange Center

The Center, which was completed in May 1990, is to be used as the base for contacts between industry, academia and government as well as with overseas organizations with respect to fundamental and advanced R&D in biotechnology. Thus, the Center's facilities will be updated to promote researcher exchange and the common use of facilities and research resources.

III-8 Application of Recombinants in Fields of Agriculture, Forestry and Fishery

1. Establishment of guidelines for application of recombinants in agriculture, forestry and fishery

A. Background

i. With the recent advancement in recombinant DNA technology development, MITI and the Ministry

of Health and Welfare (MHW), in Japan, have already enacted the guidelines concerning the industrial use of recombinants for producing pharmaceuticals, enzymes and amino acids in the fields under their jurisdictions, and some production has already been underway.

As for the recombinants in plants, many test have already been underway in the Western countries. In Japan, in December 1989, the Science and Technology Agency enacted the standards of experiments including those of non-closed systems.

ii. In view of the July 1986 recommendation of OECD, MAFF announced, in December 1986, its guideline draft for the use of recombinants. Since then, MAFF has examined the draft with comments made by various circles. In April 1989, MAFF decided to draft the "Guidelines for the use of recombinants in the fields of agriculture, forestry and fishery," and notify organizations who are interested in using recombinants, in order for these recombinants to be used properly in the fields.

B. Underlying thoughts and gist of the guidelines

i. Underlying thoughts

a. In order to ensure the orderly application of recombinant plants, their safety should be closely evaluated based on results of non-closed system experiments, and the application should be directed toward open systems in a step-by-step fashion with proper control at each step.

b. When a recombinant microorganism is used in an industrial production process, it must be carried out under certain containment conditions according to the organism's characteristics (similar to the already enforced guidelines of MITI and MHW). When the application of a recombinant microorganism in an open system is the ultimate objective, the concrete evaluation of the safety of the application will be further studied.

ii. Gist of guidelines

a. Those who undertake the application of a recombinant in the fields of agriculture, forestry and fishery must check the safety of the recombinant, e.g., the presence of harmful traits, and carry out the application according to the following guidelines which are appropriate to the type, application form and the level of safety of the recombinant.

(i) Recombinant plants

When a recombinant plant is multiplied to secure materials required for breeding, the safety for open-system application must be confirmed by applications in a simulated environment in a segregated nursery. Once the safety is confirmed, the recombinant plant can be used in an open system.

(ii) Recombinant microbes

(a) Application in production process

Those microbes that are recognized as extremely safe due to the lack of pathogenicity against humans can be applied in the minimum containment conditions (the "Good Industrial Large-Scale Practice" or GILSP application). Others must be applied under a certain set of containment conditions (Categories 1 to 3) which correspond to the safety of a particular organism.

(b) Application ultimately intended for open systems

Thorough information concerning the safety of an organism must be gathered, and a concrete safety evaluation method will be examined in the future.

b. A recombinant must be used with necessary facilities and devices; operations must be carried out with safety assurances.

c. Those who undertake the application of a recombinant may request from the Minister of Agriculture, Forestry and Fisheries a confirmation concerning the compliance to the MAFF's guidelines for their safety evaluation, facilities and devices.

For the confirmation by the Minister of Agriculture, Forestry and Fisheries, the Recombinant Application Special Committee, established in the Agriculture, Forestry and Fisheries Research Council (for animal drugs, the Biotechnology Special Committee, the Central Pharmaceutical Affairs Council, MHW) will examine and deliberate requests for the confirmation.

2. Guideline system

Chapter 1. General provisions

1. Objectives

The objectives of these guidelines shall be to determine the basic requirements for appropriate application of recombinants with a newly inserted character through the recombinant DNA technology, and to assure the safety concerning the application of recombinants in the industrial fields, including agriculture, forestry, fishery and food industry, under the jurisdiction of MAFF, for the sake of the wholesome growth of these industries.

2. Definitions

Recombinant, host, vector, donor DNA, recombinant plant, recombinant microorganism, operation area, and operation field.

Chapter 2. Safety evaluation

1. Principles

A recombinant undertaker shall be responsible for evaluating the safety of a recombinant by examining the characteristics of the recombinant based on the properties of its host, the recombinant DNA molecule and the vector, and comparing the recombinant with the host. He shall apply the recombinant in accordance with its type, application form and safety aspects.

[Recombinant plants]

(1) When a recombinant plant is multiplied to secure materials required for breeding, the safety for open-system application must be confirmed by applications in a simulated environment in a segregated nursery.

(2) Once the safety is confirmed per (1) above, the recombinant plant can be used in an open system.

[Recombinant microorganisms]

(1) Application in production process:--Recombinant microorganisms are classified into one of GILSP and Categories 1-3, depending on the level of safety, including pathogenicity, before application.

(2) Application ultimately intended for open systems:--Production shall be done according to (1) above. Recombinant microorganisms are handled by simulated environment application after safety evaluation, in order to confirm the safety for eventual open-system application. Once the safety is

confirmed, recombinant microorganisms can be used in an open system.

2. Items to be evaluated

[Recombinant plants]

(1) Purpose of recombinant plant application

(2) Host or biological species to which the host belongs

(3) Donor DNA

(4) Vector

(5) Recombinant plant

(6) Other (information obtained from recombinant DNA experiments and during cultivation)

[Recombinant microorganisms]

(1) Purpose of recombinant microorganism application

(2) Host or biological species to which the host belongs

(3) Donor DNA

(4) Vector

(5) Recombinant microorganism

(6) Other (information obtained from recombinant DNA experiments and during cultivation)

3. Application classification

[Recombinant plants]

(1) Application in simulated environment:--This is a test application which is to be run in a marked area where the environment under which a particular recombinant plant is to be grown is simulated. Measures must also be taken to prevent the plant's proliferation outside the area by letting its pollens escape outside the area.

(2) Open-system application:--A recombinant plant whose safety is confirmed can be applied in an open system.

[Recombinant microorganisms]

(1) GILSP application (minimum containment) and Categories 1-3 application (certain degree of containment depending on the nature of the organism).

(2) Application ultimately intended for open systems

Simulated environment application:--(Application of a recombinant microorganism which is classified into GILSP or Category 1 in (1) above. This application is carried out as a test in a marked area, where the eventual environment for dosing the recombinant is simulated, and under the conditions that minimize the scattering of the microorganism and the transfer of the genetic character.)

Open-system application:--Application of recombinant microorganisms whose safety has already been confirmed.

Chapter 3. Facilities, equipment and operation gist concerning recombinant handling

1. Facilities and equipment concerning recombinant handling

[Recombinant plants]

(1) An operation area must be established.

(2) Upon consideration of the plant's reproductive and multiplication forms, the availability of castration process for the plant, the plant's physiological characteristics and the peripheral biota, a required segregated nursery must be established within the operation area.

[Recombinant microorganisms]

[Application in production process]

An operation area must be established according to the level of safety, i.e., the classification of GILSP application, Category 1, 2 or 3 application, of a recombinant microorganism, and facilities and equipment with prescribed airtightness must be installed.

[Simulated environment application]

a. An operation area must be established.

b. Upon consideration of the microbe's reproduction and multiplication types, the availability of a control measure for the reproductive and multiplying capabilities, the application form in an

open system, and the peripheral biota, a required segregated nursery and a control facility must be established within the operation area.

2. Operation gist concerning recombinant handling

[Recombinant plants]

(1) Cultivation control

(2) Waste disposal

(3) Storage

(4) Transportation

(5) Maintenance of facilities and devices

(6) Other

[Recombinant microorganisms]

(1) Cultivation control

(2) Waste disposal

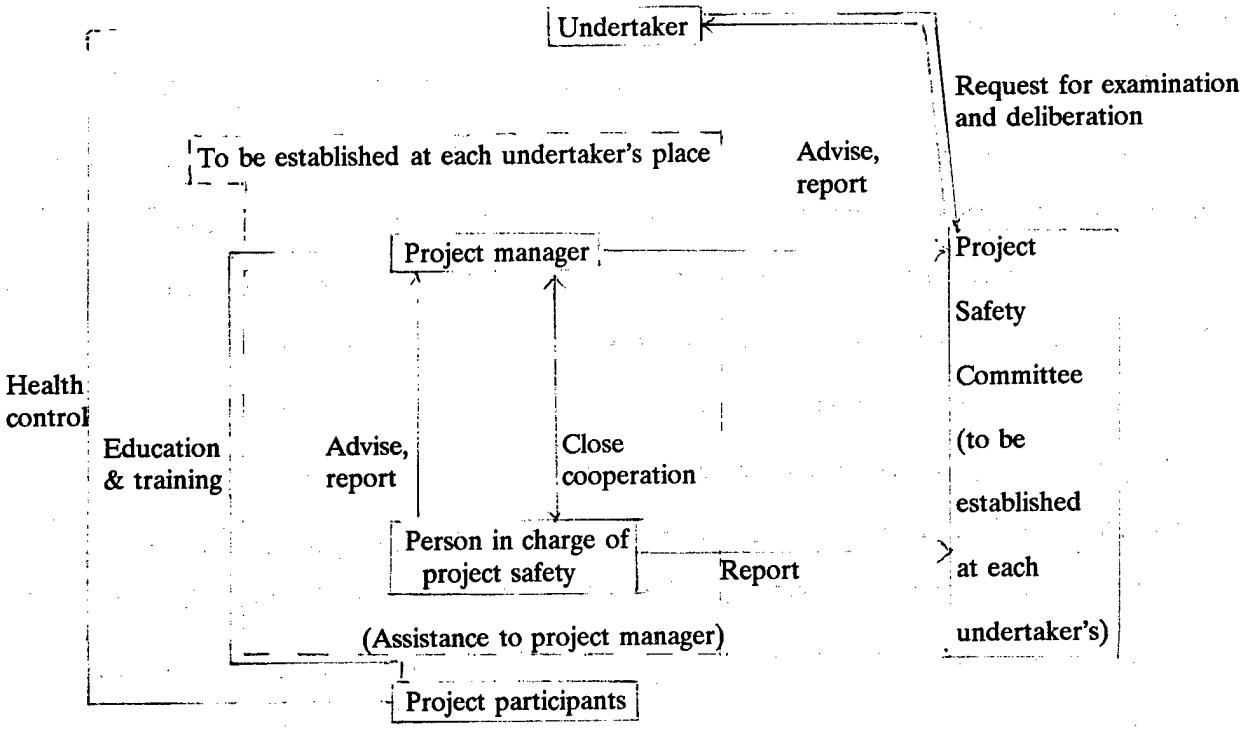
(3) Storage

(4) Transportation

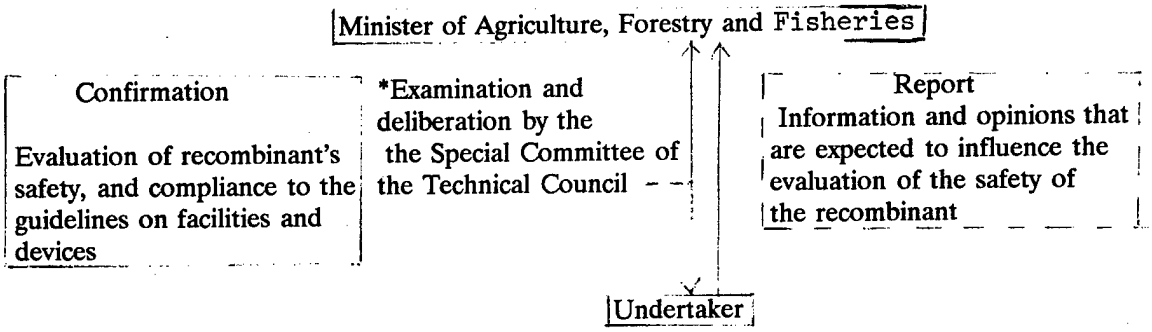
(5) Maintenance of facilities and devices

(6) Other

Chapter 4. Control system



Chapter 5. Confirmation and report



(Notes) 1. The above rectangle-enclosed sections are the regulations concerning recombinant microorganisms intended for ultimate application in an open system. Concrete procedures for evaluating the safety of these organisms will be further investigated.

2. *Prior to the issuance of confirmation by the Minister of Agriculture, Forestry and Fisheries, the Special Recombinant Application Committee of the Agriculture, Forestry and Fisheries Research Council (the Special Biotechnology Committee of the Central Pharmaceutical Affairs Council, MHW, for animal drugs) will investigate and deliberate on each application.

Chapter 6. Other matters

1. Efforts should be made to gather as much information as possible concerning the safety of a recombinant microorganism that is intended to be applied in an open system.
2. For the time being, recombinant animals are to be raised and managed in a certain controlled environment, although confirmation is required for each individual case.
3. For the time being, recombinant non-cellular organisms (for inoculating an individual animal or plant) must be handled in accordance with the regulations concerning recombinant microorganisms
4. For the time being, a self-cloned organism will be handled as a recombinant.
5. The Chief, the Secretariat of the Agriculture, Forestry and Fisheries Research Council and the heads of the bureaus and the agencies will separately decide matters concerning project operation including operation manuals.

- END -

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